IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPELLANT'S MAIN BRIEF ON APPEAL

APPELLANT(S):	FRANK MADEMANN	ATTORNEY DOCKET NO:	P98,0162
SERIAL NUMBER:	09/029,688	GROUP ART UNIT:	2683
FILED:	MARCH 3, 1998	EXAMINER:	P. Sobutka

TITLE: METHOD AND SYSTEM FOR PAGING A RADIOTELEPHONE UNIT BASED ON THE UNITS CURRENT LOCATION

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

In accordance with the provisions of 37 C.F.R. §1.192, Appellant herewith submits his Brief in support of the appeal of the above-referenced application, in triplicate, in support of the patentability of claims 1-13 finally rejected in the Office Action, Paper 13, dated October 12, 2000. A copy of the claims on appeal is attached as Appendix A. A copy of the Final Office Action, the Telephone Interview Summary, Amendment C After Final, and the Advisory Notice are attached as Appendix B. All references are to the originally filed specification unless otherwise indicated—the use of reference characters is intended to be exemplary only, and is in no way intended to limit the invention to that provided by the reference characters exclusively. A Notice of Appeal was filed on February 12, 2001.

REAL PARTY IN INTEREST

The real party in interest in this appeal is the assignee, Siemens Aktiengesellschaft, a German corporation.

RELATED APPEALS AND INTERFERENCES:

There are no related appeals and no related interferences known to Appellant, Appellant's Assignee, or Appellant's legal representative.

STATUS OF CLAIMS:

Claims 1-13 are on appeal, and constitute all pending claims of the application. The claims were rejected in the Final Office Action as Follows:

The rejected claims were rejected as follows:

Cited Para. No.	Claims	35 U.S.C. Sec.	References
1	1, 4-6, 10-13	§103(a) Obviousness	• Kauppi (U.S. Patent 5,953,667); and • Boudreau et al. (U.S. Patent 5,369,681).
2	5, 7, 8	§103(a) Obviousness	• Kauppi (U.S. Patent 5,953,667); • Boudreau et al. (U.S. Patent 5,369,681); and • Tidemann, Hr. et al. (U.S. Patent 5,588,043
3	9	§103(a) Obviousness	• Kauppi (U.S. Patent 5,953,667); and • Boudreau et al. (U.S. Patent 5,369,681).

Copies of Kauppi and Boudreau, which form the basis for appeal, have been attached as Appendix C.

STATUS OF AMENDMENTS:

Amendment B was filed on July 17, 2000, amending claims 1 and 10. Amendment C After Final was Filed on January 12, 2001 after the final rejection, Office Action, Paper 13 dated October 12, 2000 and the telephone interview conducted on December 28, 2000. The Examiner's Advisory Action dated February 7, 2001 indicated that the amendments of Amendment C would not be entered because they were not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal.

SUMMARY OF THE INVENTION:

In general terms, the present invention is system and appertaining method for sending a radio paging broadcast to radiotelephone subscriber stations of mobile radiotelephone subscribers of a cellularly constructed mobile radiotelephone network (Preamble, claim 1, amended p. 2a, lines 4-7). In the inventive system and method, when a radiotelephone subscriber station (phone) (MS) moves into a radio cell, the cell identifier (CI2) of the current radio cell (C2) and a location identifier are sent in transmitted messages (LU) sent by the phone. The transmitted cell identifier is entered into a list of cell identifiers (this list comprises cell identifiers of cells that had previously been visited and transmitted by the phone) that are stored in a subscriber database (NVLR) of the mobile radiotelephone network. This list of cell identifiers may then be utilized when sending out radio paging messages (based on the last-used radio cells)—this permits the phone to be reached without the additional signaling traffic that was previously required (amended p. 2a/8-17, 4/24-6/3, 8/4-23).

In alternative embodiments, the transmission of the radio paging broadcast may be transmitted to the last-used radio cell, or to several last-used radio cells (obtained from the list of cell identifiers). Furthermore, this transmission may also be transmitted into cells that are adjacent to the cells in the list of cell identifiers. 8/4-23.

ISSUES:

The issue on appeal is whether the subject matter of claims 1-13 are obvious under 35 U.S.C. §103(a) over Kauppi (U.S. Patent No. 5,953,667) in view of Boudreau (U.S. Patent No. 5,369,681).

GROUPING OF CLAIMS:

The claims on appeal include two independent claims (claims 1 and 10) and eleven dependent claims (2-9 depending from claim 1, and 11-13 depending from claim 10). Since the basis in dispute for the rejection of the claims revolves around

elements of independent claims 1 and 10, the patentability of claims 2 and 4-9 stands or falls together with the patentability of independent claim 1, and the patentability of claims 11 and 13 stands or falls together with the patentability of independent claim 10.

Dependent claims 3 and 12 contain a common limitation that applicants believe are separately patentable—namely that the radio paging broadcast is transmitted to several last-used radio cells that are determined by the stored cell identifiers. This limitation is significant in that it *requires* the presence of stored cell identifiers in order to transmit the paging broadcast, and the step of transmitting the paging broadcast in the manner described in these claims is not taught in the art cited against the present application. Thus, the patentability of claim 12 stands or falls together with the patentability of dependent claim 3.

ARGUMENT:

Argument 1: Obviousness in view of Kauppi and Boudreau of the present invention's list construction

Examiner's Position: The combination of Kauppi and Boudreau renders claims 1-13 obvious under 35 U.S.C. §103(a) because all of the elements of the claims are taught by this combination, with Boudreau teaching the retention of previous cell identifiers.

Kauppi's teaching--In the Final Office Action, Paper 13, at p. 2, the Examiner states (with respect to claims 1, 10) that Kauppi teaches:

> a location registration system in which mobiles transmit registration information that contains a cell identifier in addition to a location identifier (Kauppi see especially col. 1, line 60, col. 2, line 48, col. 4, lines 2142), the cell identifier and location identifier being stored in a subscriber database of the MSC (Kauppi col. 3, lines 3 3-48). Kauppi teaches that the cell identifier is used in the paging of the mobile to limit the signaling load by only paging in the identified cell (Kauppi see especially col. 1, line 60, col. 2, line 48).

Boudreau's teaching--The Examiner notes Kauppi's lack of teaching of retaining the previous cell identifiers, but utilizes Boudreau as teaching this limitation

> Kauppi lacks a teaching of retaining the previous cell identifiers. Boudreau et al teaches a registration process that retains the previous cell identifiers in order to optimize the paging areas (Boudreau see especially col. 9, lines 4-11). It would have been obvious to one of ordinary skill in the art to modify Kauppi to retain the previous cell identifiers in order to optimize the paging areas as taught by Boudreau. (p. 2)

The Examiner then stated that it would have been obvious to combine these two references. Boudreau, in the section cited by the Examiner states:

> Thereafter, at 216 the system records the identity of the location area from which the response was received and where the mobile station last registered for statistical purposes. These statistics will utilized in further optimizing the coverage of the location areas and the paging areas. The paging process ends at 218. If at 210, a page response is not received from the mobile station, the system proceeds to 220 where the timer expires.

In other words, the Examiner is stating that Boudreau's recording of the location area identity teaches the following claim elements of the present invention:

> **claim 1:** entering the transmitted cell identifier in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, and sending the paging broadcast based on the list of cell identifiers, thereby retaining transmitted cell identifiers;
>
> and
>
> **claim 10:** the mobile radiotelephone network having at least one subscriber database in which the transmitted cell identifier is entered in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, and the transmitted cell identifier is retained, the radio paging broadcast being sent based on the list of cell identifiers.

The Examiner did state in the Interview Summary, dated January 3, 2001, that an amendment limiting the claims to a simplified paging list construction would appear to distinguish over Boudreau's more complex paging area construction. Furthermore, the Examiner suggested in the Advisory Action, dated February 7, 2001, that the present invention's retention of *all* cell identifiers previously transmitted would distinguish over Boudreau.

Appellant's Position: Boudreau does not retain the transmitted cell identifiers in a list comprising the transmitted cell identifier and retained cell identifiers, but rather generates a list based on a statistical analysis and specified paging area parameters.

Present invention's list construction—The present invention, according to claims 1 and 10, requires a list of cell identifiers that are constructed in a specific manner, i.e., that a transmitted cell identifier is entered into the list, and that this transmitted cell identifier as well as the cell identifiers previously transmitted, become the list of retained cell identifiers. This list of cell identifiers is then used to transmit the paging broadcast. In other words, this list of cell identifiers is comprised of the cell identifier that was most recently transmitted by the mobile station, and retained cell identifiers that had been previously transmitted by the mobile station (5/15-6/3). When the mobile station does not respond to a paging directed to the last-used radio cell, then other prior earlier "last used" radio cells are used for the paging; it is only if paging these earlier cells do not evoke a response is the entire location area paged. 9/5-9. A teaching of such a construction is not found in Boudreau.

Boudreau's list construction--Boudreau simply records the cell identifier for statistical purposes (9/4-11 & 9/35-38). Boudreau then generates a plurality of location areas based on a statistical analysis and derives a list from specified paging area parameters (9/24-26) based on a statistical likelihood of the mobile station being found (10/1-9 & 10/30-34). This statistical information takes into account factors which include idiosyncratics of the geographic terrain and obstructions of a

system (10/20-25). We note that there are many different ways such a statistical-based list could be constructed, including the above mentioned utilization of terrain factors, distances relating to a home base area or a last used area, some form of a most historical likely location, etc. Boudreau is silent on the mechanisms of its list construction and thus cannot teach the present invention.

To summarize, Boudreau records the cell identifier but does utilize the recorded cell identifier or previously recorded cell identifiers in a list—the list of Boudreau is derived from a statistical formula based on various parameters. The present invention, by virtue of retaining a list in the network database does not require any modifications to the mobile station; the mobile station does not carry out any supplementary signal processing--all calculations and estimation work is carried out in the network.

Kauppi lacks any discussion of a list being retained based on transmitted cell identifiers that are utilized to broadcast a paging message, as argued in previous Amendment B and acknowledged by the Examiner in response.

The Examiner did state in the Advisory Action that "Boudreau performs an analysis whereby not all of the received cell identifiers would necessarily be included in the paging list. In contrast, the instant invention, as discussed in the interview and the remarks, retains all of the received cell identifiers as the paging list." p. 2. Appellants understand Boudreau as not teaching the maintenance of any <u>list</u> constructed of received cell identifiers. Nonetheless, Appellants are uncertain as to why the Examiner believes the present language of the claims is inadequate to make this distinction.

For these reasons, Appellants respectfully contend that independent claims 1 and 10, and thus, all remaining claims that depend from them are not obvious in light of the combination of Kauppi and Boudreau.

Argument 2: Obviousness in view of Kauppi and Boudreau of the present invention's list usage for sending paging (signaling) messages

Examiner's Position: The combination of Kauppi and Boudreau renders claims 3 and 12 obvious under 35 U.S.C. §103(a) because Kauppi teaches paging an identified cell and Boudreau teaches optimization of paging areas.

Kauppi's teaching--In the Final Office Action, Paper 13, at p. 2, the Examiner states (with respect to claims 1, 10, but implicitly with respect to dependent claims 3 and 12) that Kauppi teaches:

> that the cell identifier is used in the paging of the mobile to limit the signaling load by only paging in the identified cell (Kauppi see especially col. 1, line 60, col. 2, line 48).

The Examiner then states that it would be obvious to modify Kauppi to retain the previous cell identifiers in order to optimize the paging areas as taught by Boudreau (p. 2).

Boudreau's teaching--The Examiner states that it would be obvious to combine the optimization of paging areas according to Boudreau with Kauppi, and implicitly infers that this obviates the present invention's mechanism for sending the paging message according to the present invention.

In other words, the Examiner is stating that Boudreau's optimization of the paging areas teaches

> **claim 3:** The method according to claim 1, wherein the radio paging broadcast is transmitted to several last-used radio cells that are determined by the stored cell identifiers.

Appellants' Position: Boudreau's scheme for determining which cells to broadcast the paging message to relates to a statistical likelihood determination based on a last registered paging location area, which is unlike the present invention's use of stored cell identifiers.

Present Invention's paging area —The present invention, according to claims 3 and 12, requires the presence of the list of cell identifiers that was created in respective claims 1 and 10, as described above, i.e., that a transmitted cell

identifier is entered into the list, and that this transmitted cell identifier along with the cell identifiers previously transmitted, become the list of retained cell identifiers. The list constructed in this manner is used to provide the required paging information pertaining to several last-used radio cells. 9/5-9.

Boudreau's paging area—Boudreau states:

> In summary, the paging process optimizes the use of the control channel capacity by first sending a page request to the last known location of the desired mobile station. If no response is received within a specified time period, page requests are sent to a group of predetermined location areas, i.e., a paging area, which includes the location area where the desired mobile station last registered and a plurality of location areas wherein the mobile station would be statistically likely to be found if it had last registered within the previously paged location area. 9/65-10/7.

There is no discussion beyond the storage of a cell identifier or use of a cell identifier for specifying a paging area other than the one last registered with the previous location area. According to claim 3,

> **claim 3:** The method according to claim 1, wherein the radio paging broadcast is transmitted to several last-used radio cells that are determined by the stored cell identifiers.

...the radio paging broadcast is transmitted to radio cells identified in the stored cell identifiers list, and this list is constructed as described above under Appellants' Position for Argument 1.

Thus, Appellants respectfully contend that dependent claims 3 and 12 are not obvious in light of the combination of Kauppi and Boudreau.

CONCLUSION:

For the above reasons, Appellants respectfully submits that the Examiner is in error in law and in fact in rejecting claims 1-13 based on the teachings of the above-discussed references. Reversal of the rejection of all of those claims is justified, and the same is respectfully requested.

This Brief is accompanied by a check in the amount of $310.00, as required by 37 C.F.R. §1.17(c). If necessary, the Commissioner is hereby authorized to charge any additional fees which may be required to account No. 50-1519.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that an original and two copies of this correspondence are being deposited with the United States Postal Service as First Class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on April 12, 2001.

Mark Bergner - Attorney for Applicants

APPENDIX A
CLAIMS INVOLVED IN THE APPEAL

1. **(Twice amended)** A method for sending a radio paging broadcast to radiotelephone subscriber stations of mobile radiotelephone subscribers of a cellularly constructed mobile radiotelephone network, comprising the steps of:

managing locations of the radiotelephone subscriber stations by location areas that consist respectively of at least one radio cell and that are identifiable by a location area identifier;

calling radiotelephone subscriber stations in a location area by transmission of a radio paging broadcast;

sending, in a transmission of messages respectively sent by a respective radiotelephone subscriber station, a transmitted cell identifier that identifies a current radio cell in which the respective radiotelephone subscriber station is currently located, the transmitted cell identifier being sent in addition to the location area identifier;

storing the transmitted cell identifier in a subscriber database of the mobile radiotelephone network; and

entering the transmitted cell identifier in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, and sending the paging broadcast based on the list of cell identifiers, thereby retaining transmitted cell identifiers.

2. **(Amended)** The method according to claim 1, wherein the radio paging broadcast is transmitted to a last-used radio cell determined by the stored cell identifier.

3. **(Amended)** The method according to claim 1, wherein the radio paging broadcast is transmitted to several last-used radio cells that are determined by the stored cell identifiers.

4. **(Amended)** The method according to claim 1, wherein the radio paging broadcast is transmitted to a last-used radio cell, and, in addition, to radio cells adjacent thereto that are determined by the stored cell identifiers.

5. **(Amended)** The method according to claim 1, wherein to increase a certainty of a hit during calling of the respective radiotelephone subscriber station, a time of transmission of the cell identifier is stored in the subscriber database, together with the cell identifier.

6. **(Amended)** The method according to claim 1, wherein if a paging response message that can be sent back by a radiotelephone subscriber station fails to appear, the radio paging broadcast is transmitted to all radio cells of a location area.

7. **(Amended)** The method according to claim 1, wherein the cell identifier and a time of transmission of the cell identifier are stored in a decentral subscriber database that is responsible for the radiotelephone subscriber stations located in an allocated location area.

8. **(Amended)** The method according to claim 1, wherein the cell identifier and a time of transmission of the cell identifier are stored in the subscriber database, together with a subscriber identifier that identifies the mobile radiotelephone subscriber.

9. **(Amended)** The method according to claim 1, wherein the cell identifier is respectively concurrently sent in data packets that are transmitted in the mobile radiotelephone network according to a data packet service.

10. **(Twice amended)** A system for transmitting a radio paging broadcast to radiotelephone subscriber stations of mobile radiotelephone subscribers in location areas of a cellularly constructed mobile radiotelephone network, whereby the location areas respectively manage locations of the radiotelephone subscriber stations, and respectively consist of at least one radio cell, and are identifiable by a location area identifier, comprising:

the radiotelephone subscriber stations having means for transmitting messages that respectively contain, in addition to the location area identifier, a transmitted cell identifier that identifies a current radio cell in which a respective radiotelephone subscriber station is currently located; and

the mobile radiotelephone network having at least one subscriber database in which the transmitted cell identifier is entered in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, and the transmitted cell identifier is retained, the radio paging broadcast being sent based on the list of cell identifiers.

11. **(Amended)** The system according to claim 10, wherein

the mobile radiotelephone network has means for transmitting the radio paging broadcast to a last-used radio cell that is determined by the entered cell identifier.

12. **(Amended)** The system according to claim 10, wherein

the mobile radiotelephone network is provided with means for transmitting the radio paging broadcast to several last-used radio cells determined by the entered cell identifiers.

13. **(Amended)** The system according to claim 10, wherein

the mobile radiotelephone network has means for transmitting the radio paging broadcast to a last-used radio cell, and, in addition, to radio cells adjacent thereto as determined by the entered cell identifiers.

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APPENDIX B

FINAL OFFICE ACTION
AMENDMENT C AFTER FINAL
INTERVIEW SUMMARY
ADVISORY ACTION

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/029,688	03/03/98	MADEMANN F	P98.0162

LM02/1012

HILL STEADMAN & SIMPSON
85TH FLOOR SEARS TOWER
CHICAGO IL 60606

EXAMINER	
SOBUTKA, P	
ART UNIT	**PAPER NUMBER**
2683	13

DATE MAILED: 10/12/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

UNITED STATES DEPARTMENT OF COMMERCE
Patent and [illegible] Office

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Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.

EXAMINER	
ART UNIT	PAPER NUMBER
	13

DATE MAILED:

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

See Attached

Office Action Summary

Application No.	Applicant(s)
09/029,688	Mademann
Examiner	**Group Art Unit**
Philip Sobutka	2683

☒ Responsive to communication(s) filed on *Jul 20, 2000*

☒ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) *1-13* is/are pending in the applicat

Of the above, claim(s) _____ is/are withdrawn from consideration

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *1-13* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). *12*

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. Claims 1-4,6,10-13, are rejected under 35 U.S.C. 103(a) as being unpatentable over Kauppi (US 5,953,667) in view of Boudreau et al (US 5,369,681).

Consider claims 10,11,12. Kauppi teaches a location registration system in which mobiles transmit registration information that contains a cell identifier in addition to a location identifier (Kauppi see especially col 1, line 60 - col 2, line 48, col 4, lines 21-42), the cell identifier and location identifier being stored in a subscriber database of the MSC (Kauppi col 3, lines 33-48). Kauppi teaches that the cell identifier is used in the paging of the mobile to limit the signaling load by only paging in the identified cell (Kauppi see especially col 1, line 60 - col 2, line 48). Kauppi lacks a teaching of retaining the previous cell identifiers. Boudreau et al teaches a registration process that retains the previous cell identifiers in order to optimize the paging areas (Boudreau see especially col 9, lines 4-11). It would have been obvious to one of ordinary skill in the art to modify Kauppi to retain the previous cell identifiers in order to optimize the paging areas as taught by Boudreau.

As to claim 13, note that Kauppi's method includes paging to adjacent cells (Kauppi col 4, line 40 - col 5, line 25).

As to claims 1-4,6, the system of Kauppi in view of Boudreau would perform the claimed steps.

2. Claims 5,7,8, are rejected under 35 U.S.C. 103(a) as being unpatentable over Kauppi in view of Boudreau and in view of Tiedemann, Jr. et al (US 5,588,043).

As to claims 5,7,8, Kauppi in view of Boudreau lacks a teaching of storing the time of the last registration, along with the mobile, zone and cell identifiers. Tiedemann teaches storing the time of last registration in order to allow for the system to ensure minimum time between registrations (Tiedemann fig 1, item 50, col 1, line 54 - col 3, line 3, col 13, line 40 - col 14, line 65). It would have been obvious to one of ordinary skill in the art to modify Kauppi in view of Boudreau to also store registration time in order to allow the system to use the timer method of registration as taught by Tiedemann in order to ensure minimum time between registrations.

3. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kauppi in view of Boudreau.

Kauppi lacks a teaching of the identifiers being sent according to a packet data service. It would be appreciated by those skilled in the art that the above difference would depend more upon engineering design considerations than on any inventive concept limitation because the overall operation of the system would not be changed by naming any particular data transfer service. Official Notice is taken that packet data service is notoriously well known in the art. It would have been obvious to one of ordinary skill in the art to modify Kauppi to use a packet data service to transfer the identifiers in order to utilize a resource efficient transfer method.

Response to Amendment

4. Applicant's arguments with respect to claims 1-13 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. **Any response to this final action should be mailed to:**

Box AF

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 308-6296, or (703) 308-6306,

(for formal communications; please mark "EXPEDITED PROCEDURE")

(for informal or draft communications, please label "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal Drive, Arlington. VA., Sixth Floor (Receptionist).

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Philip Sobutka whose telephone number is (703) 305-4825. The examiner can normally be reached on Monday-Thursday from 8:00 AM-5:30 PM. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by phone are unsuccessful, the examiner's supervisor, Fan Tsang can be reached at 703-305-4895.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

Philip Sobutka
October 5, 2000
PJS:pjs

FAN TSANG
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2700

PTO/SB/08A (modified) 1449

U.S. Department of Commerce
Patent and Trademark Office

Docket No.	Serial No.
P98,0162	09/029,688

Applicant(s): FRANK MADEMANN

Filing Date	Group Art Unit
March 3, 1998	~~2786~~ 2683

LIST OF PRIOR ART CITED BY APPLICANT
(use several sheets if necessary)

U.S. PATENT DOCUMENTS

Examiner's Initials		Document Number	Date	Name	Class	Subclass	Filing Date If appropriate
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AG							
	AH							
	AI							
	AJ							
	AK							
	AL							
	AM							
	AN							

OTHER PRIOR ART (Including Author, Title, Date, Pertinent Pages, Etc.)

CM	AO	Jacek Biala, Mobilfunk und Intelligente Netze, Verlag Vieweg Braunschweig (1994), pages 145-146; 169-171 and 287-290. **(ENGLISH-LANGUAGE TRANSLATION ENCLOSED)**
	AP	
	AQ	
	AR	

Examiner	Date Considered
P. Sobutka	10-5-00

***EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.**

CHICAGO OFFICE
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PATENT DEPARTMENT

6600 SEARS TOWER

CHICAGO, ILLINOIS 60606-6473

Chicago
Washington
New York
Merrillville
Dublin

In re application of: FRANK MADEMANN

DOCKET NO: P98,0162

Serial No: 09/029,688

GROUP ART UNIT: 2683

Filed: MARCH 3, 1998

EXAMINER: P. SOBUTKA

For: **"METHOD AND SYSTEM FOR PAGING A RADIOTELEPHONE UNIT BASED ON THE UNITS CURRENT LOCATION**

Assistant Commissioner for Patents,
Washington, D.C. 20231

Transmitted herewith is an amendment in the above-identified application.

☒ No additional fee is required.

The fee has been calculated as shown below.

CLAIMS AS AMENDED						
	(2) CLAIMS REMAINING AFTER AMENDMENT		(4) HIGHEST NO. PREVIOUSLY PAID FOR	(5) PRESENT EXTRA	(6) RATE	(7) ADDITIONAL FEE
TOTAL CLAIMS	* 13	MINUS	** 20	-0-	( ) X 9.00 ( ) X 18.00	
INDEP. CLAIMS	* 02	MINUS	** 03	-0-	( ) X 40.00 ( ) X 80.00	
Application amended to contain any multiple dependent claims not previously paid for.				( ) YES (X) NO	( ) $135.00 ( ) $270.00 ONE TIME	
			TOTAL ADDITIONAL FEE FOR THIS AMENDMENT		NONE	

* If the entry in Column 2 is less than the entry in Column 4, write "0" in Column 5.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20 write "20" in this space.

☐ Applicant petitions the Commissioner of Patents and Trademarks to extend this time for response to the Office Action dated_____for____ month(s) so that the period for response is extended to _____. A check in the amount of $_____is attached to cover the cost of the extension.

☐ A check for $ _____ is enclosed to cover the cost of ____ extra independent claim.

☐ A check for $_____ accompanying IDS under 37 CFR 1.97(c) is attached

■ A check for $_____ and Petition for Consideration of IDS under 37 CFR 1.97(d) is attached.

The Commissioner is hereby authorized to charge any additional fees which may be required, or to credit any overpayment to account No. 50-1519. A duplicate of this sheet is enclosed.

When phoning regarding this application, please call (312) 258-5779.

BY Mark Bergner (Reg. No. 45,877)
Mark Bergner

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on January 12, 2001

Mark Bergner
Mark Bergner Attorney for Applicants

U-10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	FRANK MADEMANN	DOCKET NO:	P98,0162
SERIAL NO:	09/029,688	GROUP ART UNIT:	2746
FILED:	MARCH 3, 1998	EXAMINER:	P. Sobutka

TITLE: METHOD AND SYSTEM FOR PAGING A RADIOTELEPHONE UNIT BASED ON THE UNITS CURRENT LOCATION

Assistant Commissioner for Patents
Washington, D.C. 20231

APPOINTMENT OF ASSOCIATE POWER OF ATTORNEY

Sir:

I am an attorney designated on the Power of Attorney for the above-referenced application. I hereby appoint Mark Bergner (Reg. No. 45,877) as an associate attorney, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Submitted by,

(Reg. No.31,870)

Melvin A. Robinson
SCHIFF HARDIN & WAITE
PATENT DEPARTMENT
6600 Sears Tower
Chicago, Illinois 60606-6473
(312) 258-5785
Attorney for Applicant(s)

Date: January 12, 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CHANGE OF ADDRESS OF APPLICANTS' REPRESENTATIVE

APPLICANT:	FRANK MADEMANN	DOCKET NO:	P98,0162
SERIAL NO:	09/029,688	GROUP ART UNIT:	2746
FILED:	MARCH 3, 1998	EXAMINER:	P. Sobutka

TITLE: METHOD AND SYSTEM FOR PAGING A RADIOTELEPHONE UNIT BASED ON THE UNITS CURRENT LOCATION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Members of the firm of Hill & Simpson designated on the original Power of Attorney have merged into the firm of Schiff Hardin & Waite. All future correspondence for the above-referenced application therefore should be sent to the following address:

SCHIFF HARDIN & WAITE
Patent Department
7100 Sears Tower
Chicago, Illinois 60606-6473

Submitted by,

(Reg. No. 45,877)

Mark Bergner
SCHIFF HARDIN & WAITE
Patent Department
6600 Sears Tower
Chicago, Illinois 60606-6473
Telephone: (312) 258-5779
Attorneys for Applicants

Date: January 12, 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AMENDMENT C AFTER FINAL

APPLICANT:	FRANK MADEMANN	ATTORNEY DOCKET NO:	P98,0162
SERIAL NUMBER:	09/029,688	GROUP ART UNIT:	2746
FILED:	MARCH 3, 1998	EXAMINER:	P. Sobutka
TITLE:	METHOD AND SYSTEM FOR PAGING A RADIOTELEPHONE UNIT BASED ON THE UNITS CURRENT LOCATION		

Assistant Commissioner for Patents,
Washington, D.C. 20231

Dear Sir:

This amendment is responsive to the Office Action, Paper 13, dated October 12, 2000 and the telephone interview with the Examiner conducted on December 20, 2000.

IN THE CLAIMS

Please amend claims 1 and 10 as follows.

1. **(Amended three times)** A method for sending a radio paging broadcast to radiotelephone subscriber stations of mobile radiotelephone subscribers of a cellularly constructed mobile radiotelephone network, comprising the steps of:

managing locations of the radiotelephone subscriber stations by location areas that consist respectively of at least one radio cell and that are identifiable by a location area identifier;

calling radiotelephone subscriber stations in a location area by transmission of a radio paging broadcast;

sending, in a transmission of messages respectively sent by a respective radiotelephone subscriber station, a transmitted cell identifier that identifies a current radio cell in which the respective radiotelephone subscriber station is currently

located, the transmitted cell identifier being sent in addition to the location area identifier;

storing the transmitted cell identifier in a subscriber database of the mobile radiotelephone network; [and]

entering the transmitted cell identifier in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, [and sending the paging broadcast based on the list of cell identifiers,] thereby retaining transmitted cell identifiers; and

sending the paging broadcast to at least one cell listed in the list of cell identifiers.

10. **(Amended three times)** A system for transmitting a radio paging broadcast to radiotelephone subscriber stations of mobile radiotelephone subscribers in location areas of a cellularly constructed mobile radiotelephone network, whereby the location areas respectively manage locations of the radiotelephone subscriber stations, and respectively consist of at least one radio cell, and are identifiable by a location area identifier, comprising:

the radiotelephone subscriber stations having means for transmitting messages that respectively contain, in addition to the location area identifier, a transmitted cell identifier that identifies a current radio cell in which a respective radiotelephone subscriber station is currently located; and

the mobile radiotelephone network having at least one subscriber database in which the transmitted cell identifier is entered in a list of cell identifiers comprising both the transmitted cell identifier and retained cell identifiers which were formerly transmitted cell identifiers, and the transmitted cell identifier is retained, the radio paging broadcast being sent to at least one cell listed in [based on] the list of cell identifiers.

REMARKS

Applicants have amended the claim language to clarify that the radio paging broadcast is sent to specific cells provided in the list of cell identifiers that was

created from transmitted cell identifiers. Applicants find support for this amendment in the original Specification at 2/26-27 "a paging is carried out to the last-used radio cell or cells...", at 5/15 – 6/3, and at 9/5-16.

35 U.S.C. §103 Claims 1 and 10 in view of Kauppi and Boudreau

Present invention's list construction—The present invention, with claims 1 and 10 amended as above, require a list of cell identifiers that are constructed in a specific manner, i.e., that a transmitted cell identifier is entered into the list, and that this transmitted cell identifier as well as all of those cell identifiers previously transmitted, become the list of retained cell identifiers. This list of cell identifiers is then used to transmit the paging broadcast. A teaching of such a construction is not found in Boudreau.

Boudreau's list construction--Boudreau simply records the cell identifier for statistical purposes (9/4-11 & 9/35-38). Boudreau then generates a plurality of location areas based on a statistical analysis and derives the list from specified paging area parameters (9/24-26) based on a statistical likelihood of the mobile station being found (10/1-9 & 10/30-34). This statistical information takes into account factors such as idiosyncratics of the geographic terrain and obstructions of a system (10/20-25). We note that there are many different ways such a statistical-based list could be constructed, including the above mentioned utilization of terrain factors, distances relating to a home base area or a last used area, some form of a most historical likely location, etc. Boudreau is silent on the mechanisms of its list construction.

To summarize, Boudreau in no way discloses utilizing the list of retained cell identifiers as does the present invention, but rather utilizes a list based on a statistical formula based on parameters.

Kauppi lacks any discussion of a list being retained based on transmitted cell identifiers that are utilized to broadcast a paging message.

Thus, Applicant believes that independent claims 1 and 10, and thus, all remaining claims that depend from them are not obvious in light of the combination of Kauppi and Boudreau.

The Examiner has rejected claims 5, 7, and 8 in view of the combination of Boudreau, Kauppi, and Tiedemann. Applicants rely on the above arguments and respectfully assert that Tiedemann does not add any disclosure related to the list construction and subsequent transmission of the paging broadcast to areas identified in the list—Tiedemann was cited by the Examiner as relating only to storing a time of last registration.

Applicants believe that the present amendment to the claims distinguishes the present invention from the disclosures of the art cited above and respectfully ask that the Examiner withdraw the 35 U.S.C. §103 rejection from the present application.

Conclusion

Inasmuch as each of the rejections have been overcome by amendments to the specification and the claims, and by the applicants' arguments indicating clear distinctions between the present invention and the art cited against it, it is respectfully requested that the present application be reconsidered, the rejections be withdrawn and that this application be passed to issue.

Respectfully submitted,

Mark Bergner (Reg. No. 45,877)

Mark Bergner
Schiff Hardin & Waite
7100 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6473
(312) 258-5779
Attorneys for Applicant

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D C 20231 on January 12, 2001

Mark Bergner
Attorney for Applicants

491

MF

UNITED STA..S DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
[illegible]	03/03/98	[illegible]	[illegible]

[illegible]

[illegible]
[illegible]
[illegible]

EXAMINER	
[illegible]	
ART UNIT	**PAPER NUMBER**
2683	

DATE MAILED: 01/03/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Tr. nark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

NW

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.

EXAMINER	
ART UNIT	PAPER NUMBER
	14

DATE MAILED:

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

See Attached

Interview Summary	Application No.	Applicant(s)	
	09/029,688	MADEMANN, FRANK	
	Examiner	Art Unit	
	Philip J. Sobutka	2683	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Philip J. Sobutka*. (3)_____.

(2) *Mark Bergner*. (4)_____.

Date of Interview: *28 December 2000* .

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: .

Claim(s) discussed: *1* .

Identification of prior art discussed: *Boudreau* .

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *discussed possible amendments to overcome boudreau. The examiner agreed that an amendment limiting the claims to a simplified paging list construction would appear to distinguish over Boudreau's more complex paging area construction.*
Note that Mr. Bergner's faxed discussion points have been attached to the file. .

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

i)☒ It is not necessary for applicant to provide a separate record of the substance of the interview(if box is checked).

Unless the paragraph above has been checked, THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

William G. Trost
Supervisory Primary Examiner

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/029,688	03/03/98	MADEMANN F	P98,0160

TM02/0207

SCHIFF HARDIN & WAITE
PATENT DEPARTMENT
7100 SEARS TOWER
CHICAGO IL 60606-6473

EXAMINER	
SOBUTKA,P	
ART UNIT	**PAPER NUMBER**
2683	17

DATE MAILED: 02/07/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

.. 2/95)

2 - Mail Copy

Advisory Action	Application No.	Applicant(s)	
	09/029,688	MADEMANN, FRANK	
	Examiner	Art Unit	
	Philip J. Sobutka	2683	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 16 January 2001 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE. Therefore, further action by the applicant is required to avoid abandonment of this application. A proper reply to a final rejection under 37 CFR 1.113 may only be either: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114.

PERIOD FOR REPLY [check only a) or b)]

a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.

b) ☐ In view of the early submission of the proposed reply (within two months as set forth in MPEP § 706.07 (f)), the period for reply expires on the mailing date of this Advisory Action, OR continues to run from the mailing date of the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

1. ☐ A Notice of Appeal was filed on _____. Appellant's Brief must be filed within the period set forth in 37 CFR 1.192(a), or any extension thereof (37CFR 1.191(d)), to avoid dismissal of the appeal.

2. ☐ The proposed amendment(s) will be entered upon the timely submission of a Notice of Appeal and Appeal Brief with requisite fees.

3. ☒ The proposed amendment(s) will not be entered because:

   (a) ☐ they raise new issues that would require further consideration and/or search. (see NOTE below);

   (b) ☐ they raise the issue of new matter. (see Note below);

   (c) ☒ they are not deemed to place the application in better form for appeal by materially reducing or simplifying th issues for appeal; and/or

   (d) ☐ they present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____.

4. ☐ Applicant's reply has overcome the following rejection(s): _____.

5. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendmen canceling the non-allowable claim(s).

6. ☒ The a)☐ affidavit, b)☐ exhibit, or c)☒ request for reconsideration has been considered but does NOT place the application in condition for allowance because: *See Continuation Sheet*.

7. ☐ The affidavit or exhibit will NOT be considered because it is not directed SOLELY to issues which were newly raised by the Examiner in the final rejection.

8. ☒ For purposes of Appeal, the status of the claim(s) is as follows (see attached written explanation, if any):

   Claim(s) allowed: _____.

   Claim(s) objected to: _____.

   Claim(s) rejected: *1-13*.

   Claim(s) withdrawn from consideration: _____.

9. ☐ The proposed drawing correction filed on _____ a)☐has b)☐ has not been approved by the Examiner.

10. ☐ Note the attached Information Disclosure Statement(s)(PTO-1449) Paper No(s). _____.

11. ☐ Other:

Continuation of 6. does NOT place the application in condition for allowance because: applicant's comments in the remarks section, namely that "a transmitted cell identifier is entered into the list, and that this transmitted cell identifier as well as ALL of those cell identifiers prieviously transmitted, become the list of retained cell identifiers" (emphasis added) are not commensurate with the scope of the claims. To elaborate, the essential difference between the instant invention and Boudreau, as discussed in the interview, relates to the construction of the paging list. Boudreau performs an analysis, whereby not all of the received cell identifiers would necessarily be included in the paging list. In contrast, the instant invention, as discussed in the interview and the remarks, retains all of the received ce identifiers as the paging list.

William G. Trost
Supervisory Primary Examiner

APPENDIX C

KAUPPI PATENT
BOUDREAU PATENT

US005953667A

United States Patent [19]

Kauppi

[11] Patent Number: 5,953,667

[45] Date of Patent: *Sep. 14, 1999

[54] **LOCATION UPDATING IN A CELLULAR RADIO NETWORK**

[75] Inventor: **Hanna-Maria Kauppi**, Espoo, Finland

[73] Assignee: **Nokia Telecommunications OY**, Espoo, Finland

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/859,417**

[22] Filed: **May 20, 1997**

Related U.S. Application Data

[63] Continuation of application No. 08/403,701, filed as application No. PCT/FI93/00371, Sep. 15, 1993, abandoned.

[30] **Foreign Application Priority Data**

Sep. 18, 1992 [FI] Finland 924199

[51] **Int. Cl.**[6] **H04Q 7/20**

[52] **U.S. Cl.** **455/440**; 455/417; 455/671; 455/435

[58] **Field of Search** 455/417, 432, 455/435, 440, 422, 426, 67.1

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,737,978	4/1988	Burke et al.	379/60
4,775,999	10/1988	Williams	379/59
5,054,110	10/1991	Comroe et al.	455/33
5,629,975	5/1997	Tiedemann	455/435

FOREIGN PATENT DOCUMENTS

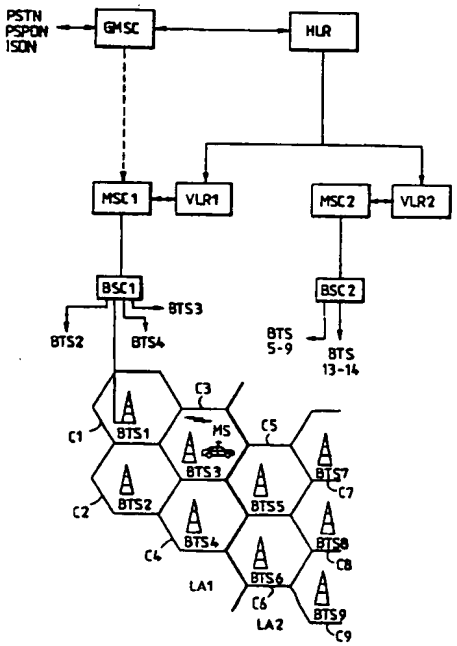
0260763	3/1988	European Pat. Off. .
0475865	3/1992	European Pat. Off. .

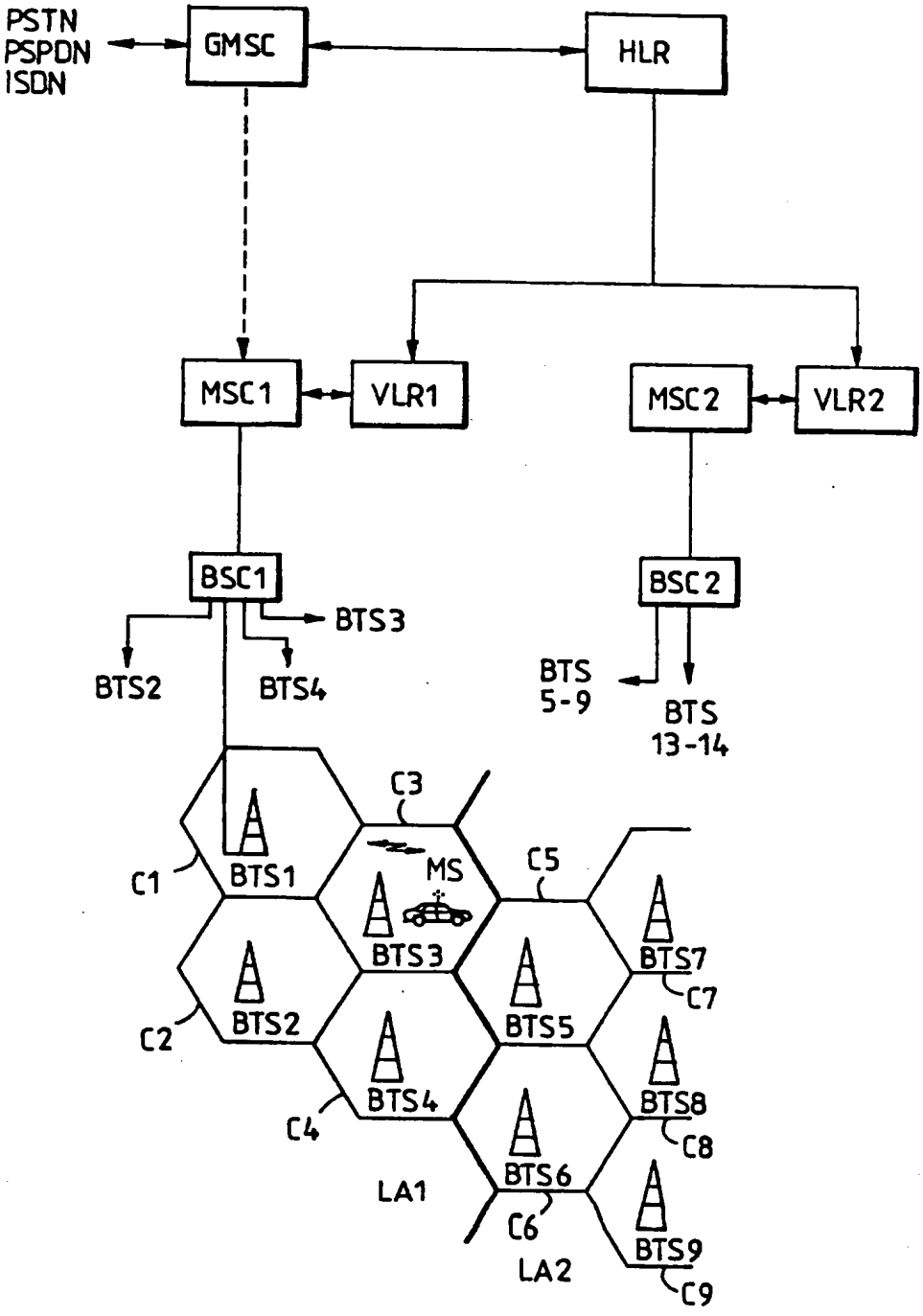
Primary Examiner—Reinhard J. Eisenzopf
Assistant Examiner—Darnell R. Armstrong
Attorney, Agent, or Firm—IP Group of Pillsbury; Madison & Sutro LLP

[57] **ABSTRACT**

In a cellular radio network in which mobile stations roam, in addition to location updating of each mobile station with the accuracy of one location area, a so-called temporary subscriber-specific paging area is determined. Each mobile station initiates the determining of the temporary paging area in the subscriber data base of the cellular radio network after being located in a cell for a sufficiently long period. The temporary paging area is smaller than the location area (e.g., one cell and possibly at least one adjacent cell), and thus the paging of a mobile station can be focused on a small area, i.e., the temporary paging area. It is thus unnecessary to page over the entire location area, and paging time can be reduced and capacity of the cellular radio network spared.

1 Claim, 3 Drawing Sheets




PSTN
PSPDN
ISDN
GMSC
HLR
MSC1
VLR1
MSC2
VLR2
BSC1
BSC2
BTS3
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BTS
5-9
BTS
13-14
C3
C1
BTS1
MS
C5
BTS3
BTS7
C7
BTS2
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C4
C8
BTS6
LA1
C6
BTS9
LA2
C9

FIG. 1

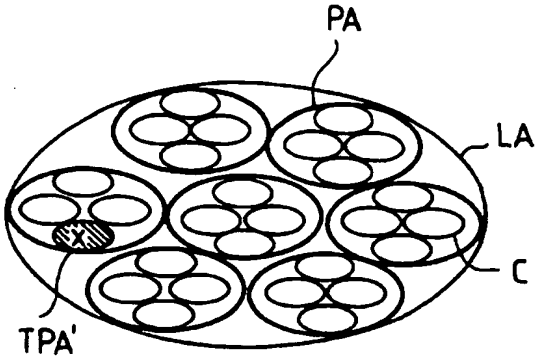

FIG. 2

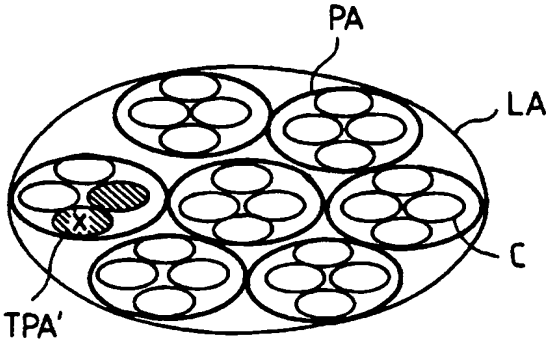

FIG. 3

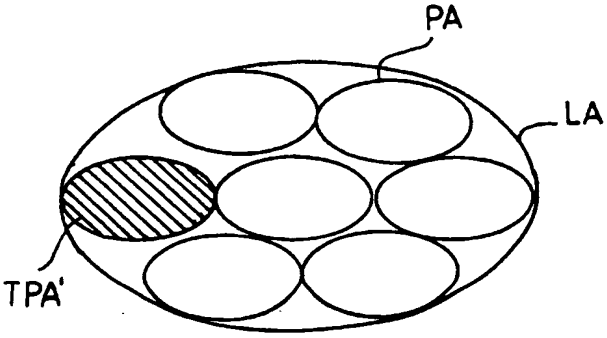

FIG. 4

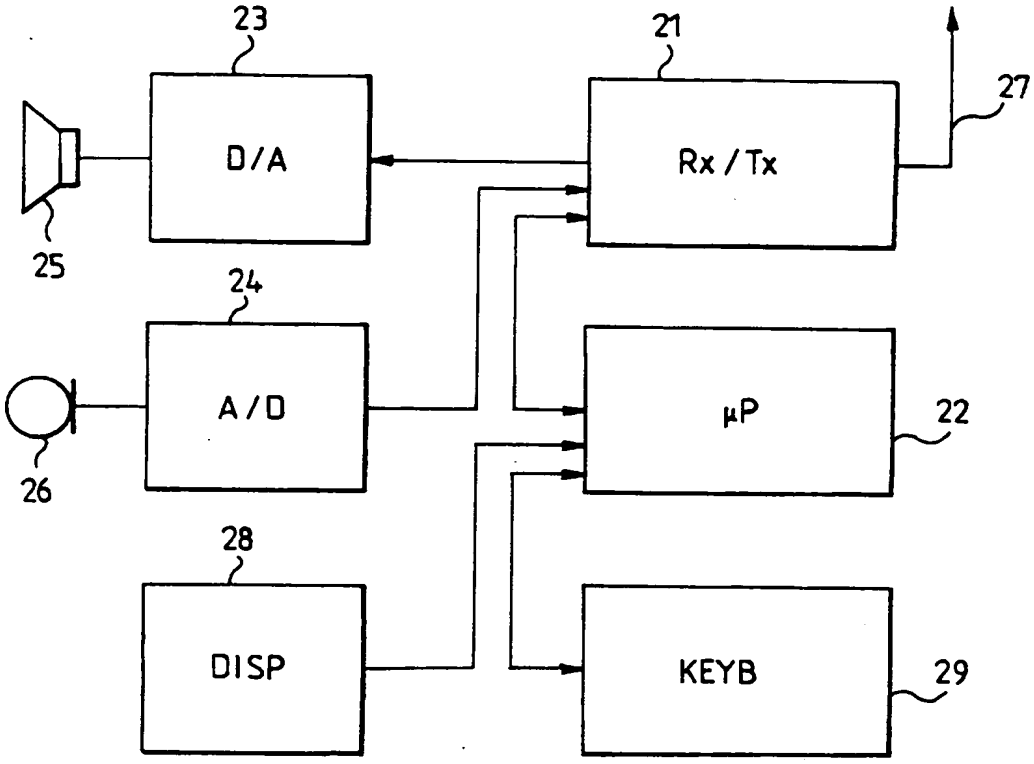

FIG. 5

LOCATION UPDATING IN A CELLULAR RADIO NETWORK

This is a continuation of application Ser. No. 08/403,701, filed on Mar. 17, 1997, now abandoned, which is a 371 of PCT/FI93/00371, filed Sep. 15, 1993.

FIELD OF THE INVENTION

The invention relates to cellular radio networks and particularly to location updating in the cellular radio networks.

BACKGROUND OF THE INVENTION

At present, various cellular or mobile radio systems are in use or under development. When a mobile station (MS) is located in a cell, it communicates with the fixed network through a fixed radio station or base station located in the cell. The mobile stations belonging to the cellular system are allowed to roam freely within the area of the cellular system from one cell to another. The cellular radio network usually has information about the location of the MS with the accuracy of a so-called location area, which includes a suitable number of predetermined cells and their base stations. The location area data transmitted by the base station indicates to the MS the location area of the base station. When the MS changes a cell within the same location area, no updating of the location for the cellular radio network is necessary. Instead, when the MS detects on the basis of the location area data that the location area changes with the new base station, the MS initiates location updating by transmitting a location updating request to the cellular radio network. Due to the location updating request, the cellular radio network updates the new location area of the MS to a subscriber database.

As the location of the MS is known only with the accuracy of one location area, the MS has to be paged in all cells within the location area in question for the setup of an incoming call. This causes a considerable signalling load in the radio network between the mobile exchange and the base stations, as well as over the radio path. On the other hand, if the size of the location area is reduced to avoid the above drawback, the MS changes the location area more often; and so the location updating frequency of the subscribers and associated signalling increase. At present there is a tendency to enlarge location areas to reduce location updating.

When location areas are large, it may be advantageous to divide them into smaller paging areas. Since the location of the subscriber is known only with the accuracy of one location area, the first paging may even here be directed to a wrong location area; in the worst case the subscriber may not be found until the paging has proceeded to the last paging area. To reduce the signalling load, measures are needed even here to focus the paging of a subscriber on a small area and yet to maximize the probability of successful paging.

SUMMARY OF THE INVENTION

The object of the present invention is a cellular radio network with a reduced signalling load caused by paging of a subscriber.

This is achieved with a cellular radio network comprising mobile stations roaming in the cellular radio network and means for storing information about the location of the mobile stations for paging in the cellular radio network with the accuracy of one location area consisting of a plurality of cells, characterised in that the mobile station comprises timing means, which start to operate as the mobile station enters a cell and, when the mobile station has stayed in the cell for at least a predetermined period, activate the mobile station to initiate in the cellular radio network a procedure in which the cellular radio network determines a temporary paging area within the current location area of the mobile station and stores the temporary paging area in the location data; the temporary paging area comprising at least the current location cell and possibly at least one adjacent cell, and any subsequent pagings of the mobile station being conducted first in said temporary paging area until the mobile station has entered a new location area or initiated determining of a new temporary paging area.

The invention also relates to a mobile station in a cellular radio network comprising mobile stations roaming in the cellular radio network and means for storing information about the location of the mobile stations for paging in the cellular radio network with the accuracy of one location area comprising a plurality of cells. In the invention, the mobile station comprises timing means, which start to operate as the mobile station enters a cell and, when the mobile station has stayed in the cell for at least a predetermined period, activate the mobile station to initiate in the cellular radio network a procedure in which the cellular radio network determines a temporary paging area within the current location area of the mobile station and stores the temporary paging area in the location data; the temporary paging area comprising at least the current location cell and possibly at least one adjacent cell.

In addition to location updating of the MS with the accuracy of one location area, a basic idea of the invention is to determine a so-called temporary subscriber-specific paging area. The MS initiates the determining of such a temporary paging area in the subscriber database of the cellular radio network after being located in an area smaller than the location area, perhaps only one or a few cells large, for a sufficiently long period. Due to this, when the location area has been detected, the paging of the MS can be focused on a small area, i.e. the temporary paging area. It is thus unnecessary to page over the entire location area, and paging time can be reduced and capacity of the cellular radio network spared. If the MS is not found in this determined temporary paging area, paging can be conducted in the remaining parts of the location area. It is then possible to further reduce signalling in the cellular radio network by paging in the remaining areas gradually, starting, e.g., from the cells/paging areas adjacent to the temporary paging area.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described by means of exemplifying embodiments with reference to the attached drawing, in which:

FIG. 1 shows a general view of a cellular radio network in which the present invention is applied,

FIGS. 2, 3 and 4 show an alternative type of location area, in which the location area consists of fixed paging areas comprising a few cells, and

FIG. 5 shows a general block diagram of a roaming mobile station.

A DETAILED DESCRIPTION OF THE INVENTION

The present invention may be applied to any cellular system, such as GSM (Global System for Mobile

Communications), NMT (Nordic Mobile Telephone), DCT 1800, PCN (Personal Communication Network), UMC (Universal Mobile Communication), UMTS (Universal Mobile Telecommunication System), and FPLMTS (Future Public Land Mobile Telecommunication System).

As is well known, the geographical area covered by a cellular radio network is divided into smaller separate radio areas or cells. When a mobile station MS resides in a cell, it communicates with the network through a fixed radio station or base station BS located in the cell. The mobile stations MS belonging to the system are allowed to roam freely within the system from one cell to another. However, the cellular radio network has to have information about the actual location of the MS to be able to route the incoming calls to the MS or to page the MS for some other reason. Typically, the cellular network has the location data of the MS with the accuracy of a larger area, generally known as a location area, comprising several cells.

The base stations of the cellular network continuously transmit information about themselves and their surroundings, the information including LAI (Location Area Identifier), BSI (Base Station Identifier), BSTI (Base Station Type Identifier), and so-called adjacent cell data. On the basis of the location area identifier transmitted by a base station BS, an MS residing in a cell can identify the location area of that BS. If the MS detects that the LAI changes as the BS changes, i.e. the location area changes, the MS initiates location updating by sending a location updating request to the cellular radio network. On the other hand, if the location area does not change, the MS does not initiate location updating.

Location updating causes updating of subscriber data of the MS in question in the subscriber database(s) of the cellular radio network. For example, in the GSM illustrated in FIG. 1, the cellular radio network comprises at least a home location register (HLR), visitor location registers (VLR), mobile exchanges (MSC) and base station controllers (BSC) connected to the base stations (BTS) of the network. The location area data of the MS are stored in a visitor location register VLR. Typically one VLR is provided for each mobile exchange MSC. A home location register HLR contains information about the VLR that the MS is visiting. The structure and operation of the GSM are described more closely in this respect e.g. in patent application Ser. No. 921,074. Apart from the centralized database structure described above, the cellular radio system may also have some kind of decentralized database structure.

For the sake of clarity, FIG. 1 shows only two location areas LA1 and LA2, the former being within the area of the mobile exchange MSC1 and the latter, of the mobile exchange MSC2. The area of one MSC typically comprises a plurality of location areas. The location area LA1 comprises e.g. cells C1 to C4, which include base stations BTS1 to BTS4 respectively. The location area LA2 comprises e.g. cells C5 to C9, which include base stations BTS5 to BTS9 respectively. An MS roaming in a cell C provides a two-way radio connection with the base station BTS of the cell concerned. The traffic in the location areas LA1 and LA2 is controlled by the base station controllers BSC1 and BSC2 respectively.

As stated above, the cellular networks typically have information about the location of the MS with the accuracy of one location area. To determine the more accurate location of the MS within the location area, the paging of the MS in conventional cellular radio networks is conducted through all the base stations in the location area. Alternatively, it has also been possible to conduct paging in fixed paging areas smaller than the location area without having information about the actual area in which the MS is located; because of this, paging may have to be conducted in several paging areas before the MS is found.

This increases the signalling load in the cellular radio network and prolongs paging times. In a cellular radio network according to the invention an MS is capable of initiating the determining of a temporary user-specific paging area in the cellular radio network; consequently the cellular radio network stores in its subscriber databases the location area and its fixed paging area or information about the cell in which the MS is located upon initiating the determining of a temporary paging area. A temporary paging area is thus always smaller than the location area; it comprises at least the cell in which the MS is currently located and possibly a few adjacent cells. On account of this, subsequent pagings of the MS can be focused on a small area within the location area where the MS is most likely to be located.

The operation of the invention is now described in greater detail with reference to FIGS. 2, 3 and 4. The location areas LA are shown to comprise a plurality of smaller fixed paging areas PA, each of which comprises one or more cells C. With reference to FIG. 2, it is assumed that the MS is within the location area LA and roams into a cell C within a paging area PA, the cell being marked with letter X. When the MS enters the cell X, it detects the change of cell e.g. by a base station identifier BSI and starts its internal timer, which measures the time spent in the cell. When the MS has stayed in the cell X for a predetermined time, i.e. the internal timer of the MS has reached a predetermined value, the timer activates the MS to send an initiation message to the cellular radio network. The initiation message initiates a procedure in the cellular radio network for determining the temporary paging area of the MS and for storing the temporary paging area in the subscriber database of the network. The temporary paging area may be, e.g.:

a) the current location cell X of the MS (shaded area TPA' in FIG. 2),

b) the current location cell of the MS and at least one adjacent cell (shaded areas TPA' in FIG. 3), or

c) a fixed paging area PA in the network, to which the current location cell X of the MS belongs (shaded area TPA' in FIG. 4).

In alternative a), in which only information about the temporary location cell X of the MS is stored in the subscriber database, the cellular radio network looks for data about the location area and the location cell X in the subscriber database during the subsequent paging of the MS, and can on the basis of the data found page the MS either only in the stored location cell X or—to enhance the probability of successful paging—both in the stored location cell X and in an adjacent cell or adjacent cells, or over the entire paging area PA of the network to which the stored location cell X belongs. The most flexible way of storing a temporary paging area TPA' in the cellular network is the one described in alternative a) since it is not until the actual paging that it has to be decided in how large an area paging will be conducted.

In alternative b), in which the location cell X of the MS and at least one adjacent cell are stored in the subscriber database, the subsequent paging of the MS is conducted primarily in the cells in question.

In alternative c), in which data about a fixed paging area PA determined on the basis of the current location cell of the

EVIDENCE THAT KAUPPI IS NOT KEEPING A LIST

MS is stored in the subscriber database, the cellular radio network conducts the subsequent paging of the MS directly in the paging area PA indicated by said stored data.

Alternatives a) and b) show flexible ways of using a temporary paging area TPA' since they are also well applicable to cases where the configuration of a paging area PA within a location area LA is varied dynamically. Alternatives a) and b) can also be applied when the location area LA of the network does not have a specific structure of paging areas PA, whereby paging is focused with the accuracy of one or a few cells. This is the case, e.g. with the present GSM cellular radio system.

In all alternatives a), b) and c), paging is extended to the remaining areas of the location area LA if the MS is not found in the first paging in the temporary paging area TPA'. The paging may then be immediately extended over the entire location area, e.g. by conducting a new paging first in the paging areas PA adjacent to the temporary paging area TPA'.

The temporary paging area TPA' of the MS determined in the above-described manner in the subscriber database of the cellular radio network does not change until the MS enters another location area LA and conducts normal location updating, or until the MS enters a new cell C and stays there for so long that the internal timer of the MS initiates the determining of a new temporary paging area for the MS.

Since all modern mobile stations are controlled by microprocessors, the timer and other necessary functions according to the invention can easily be embodied by means of softwear in a manner obvious to one skilled in the art. The procedure for determining a temporary paging area may be, e.g., modified from the conventional procedure for location updating.

FIG. **5** shows a general block diagram of a mobile station MS to which the invention may be applied. The MS comprises a transceiver **21** connected to an antenna **27**, the receiver being connected to a loudspeaker **25** via digital analog and baseband circuits **23** and the transmitter being connected to a microphone **26** via analog digital converter and baseband circuits **24**. The operation of the MS is controlled by a microprocessor **22**, which processes the signalling transmitted and received by the transceiver. The user interface comprises a display **28** and a key board **29**, which are connected to the microprocessor **22**. The invention can be carried out by modifying the software of the microprocessor **22** in such a way that it performs the operations described above.

The drawig figures and the associated description are only intended to illustrate the present invention. In its details, the cellular radio network and mobile station according to the invention may vary within the scope of the attached claims.

I claim:

1. A cellular radio network, comprising:

a plurality of fixed location areas, each location area consisting of a plurality of cells;

a plurality of mobile stations roaming in the cellular radio network; and

means for storing, as location data including respective current location areas, information about the locations of said mobile stations for paging in the cellular radio network with the accuracy of one location area;

each of said mobile stations being arranged to update the location data in said means when said respective mobile station moves from one of said location areas to another;

each of said mobile stations comprising an internal timer which starts to operate as the respective mobile station enters a respective cell and when the respective mobile station has stayed in the respective cell for at least a predetermined period of time measured by said time, activates the respective mobile station to initiate in the cellular radio network a procedure in which the cellular radio network determines a temporary mobile-specific paging area for the respective mobile station within the current location area of the respective mobile station and stores the respective temporary paging area of the respective mobile station in the location data, the temporary mobile-specific paging area comprising at least the current location cell and possibly at least one adjacent cell and containing fewer cells than a respective location area;

said storing means being arranged to store, in addition to the location area, said temporary paging area until the mobile station has entered a new location area or initiated a procedure for determining a new temporary paging area;

said cellular radio network being arranged to conduct any paging of any one of said mobile stations first in a temporary paging area indicated by the location data of said respective mobile station in said storing means, if the location data contains said temporary paging area in addition to said location area; and

said cellular radio network being arranged to conduct any paging of any one of said mobile stations in the location area indicated by the location data of said respective mobile station in said storing means, if the location data contains only said location area.

* * * * *

US005369681A

United States Patent [19]

Boudreau et al.

[11] Patent Number: 5,369,681

[45] Date of Patent: Nov. 29, 1994

[54] CELLULAR COMMUNICATIONS SYSTEM UTILIZING PAGING AREAS

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[73] Assignee: Telefonaktiebolaget L M Ericsson, Stockholm, Sweden

[21] Appl. No.: 882,607

[22] Filed: May 12, 1992

[51] Int. Cl.[5] H04M 11/00; H04Q 7/00; G08B 5/22

[52] U.S. Cl. 379/87; 379/59; 455/33.1; 340/825.44

[58] Field of Search 340/825.03, 825.44, 340/825.47; 379/56, 57, 58, 59, 60; 455/33.1, 33.2

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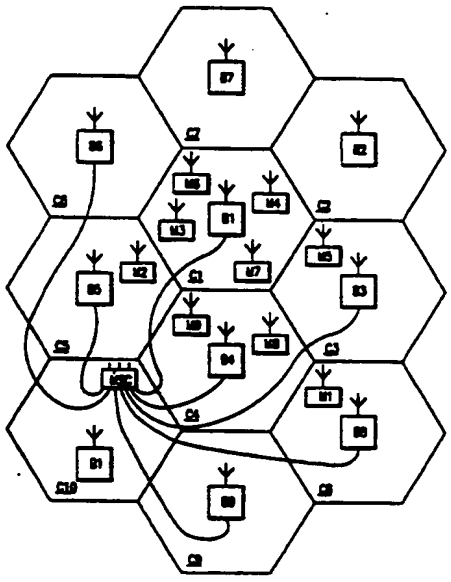
Primary Examiner—Curtis Kuntz
Assistant Examiner—William Cumming
Attorney, Agent, or Firm—Johnson & Wortley

[57] ABSTRACT

A system for paging mobile stations within a cellular telecommunication system wherein paging areas, which are composed of a plurality of location areas, are created to provide a means for locating a mobile station when the mobile station has not responded to a location area page and without requiring a service area page. The system sends a page request to the location area where the desired mobile station last registered. If a response is not received, the system sends a page request to the paging area which includes a plurality of location areas where the mobile station is likely to be found. If a page response is still not received from the desired mobile station, then a page request will be sent to all of the location areas within the service area.

4 Claims, 3 Drawing Sheets



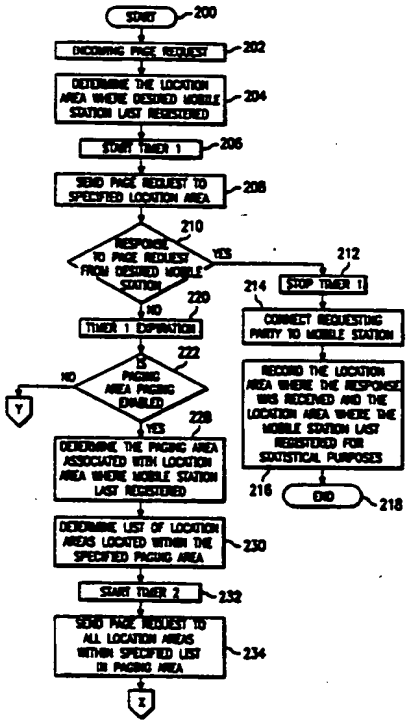
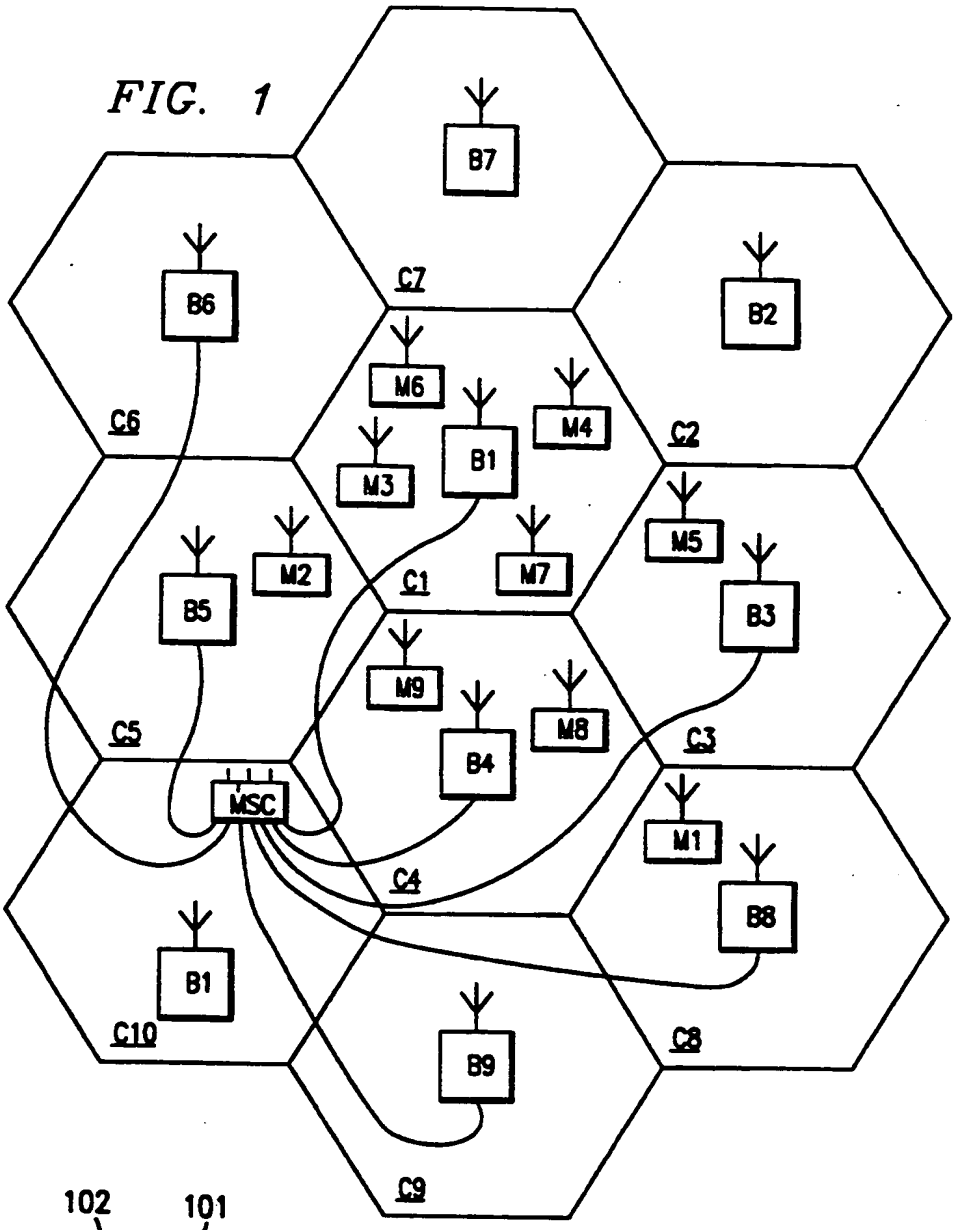


FIG. 1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B6
B2
C7
M6
M4
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B3
M9
M8
C5
C3
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MSC
M1
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B8
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C10
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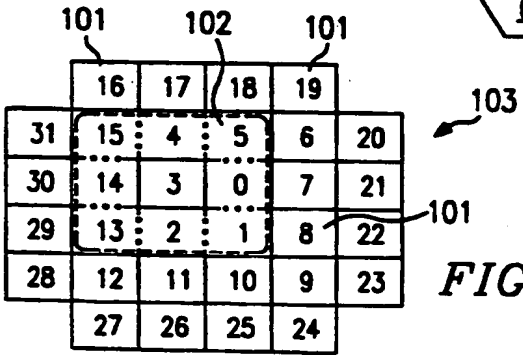
B9
C9


101
102
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16
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18
19
103
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5
6
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14
3
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7
21
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2
1
8
22
28
12
11
10
9
23
27
26
25
24

FIG. 2

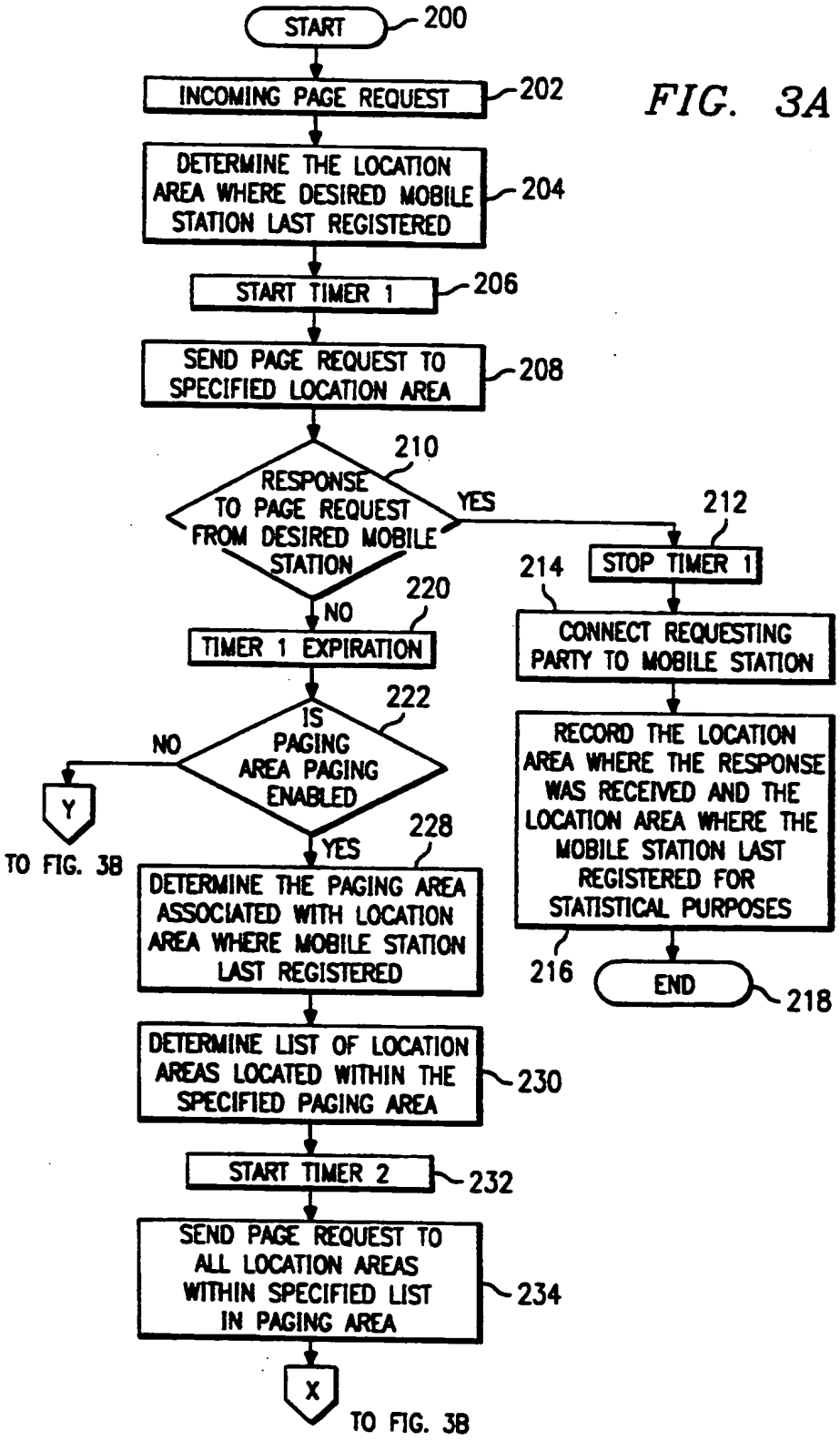
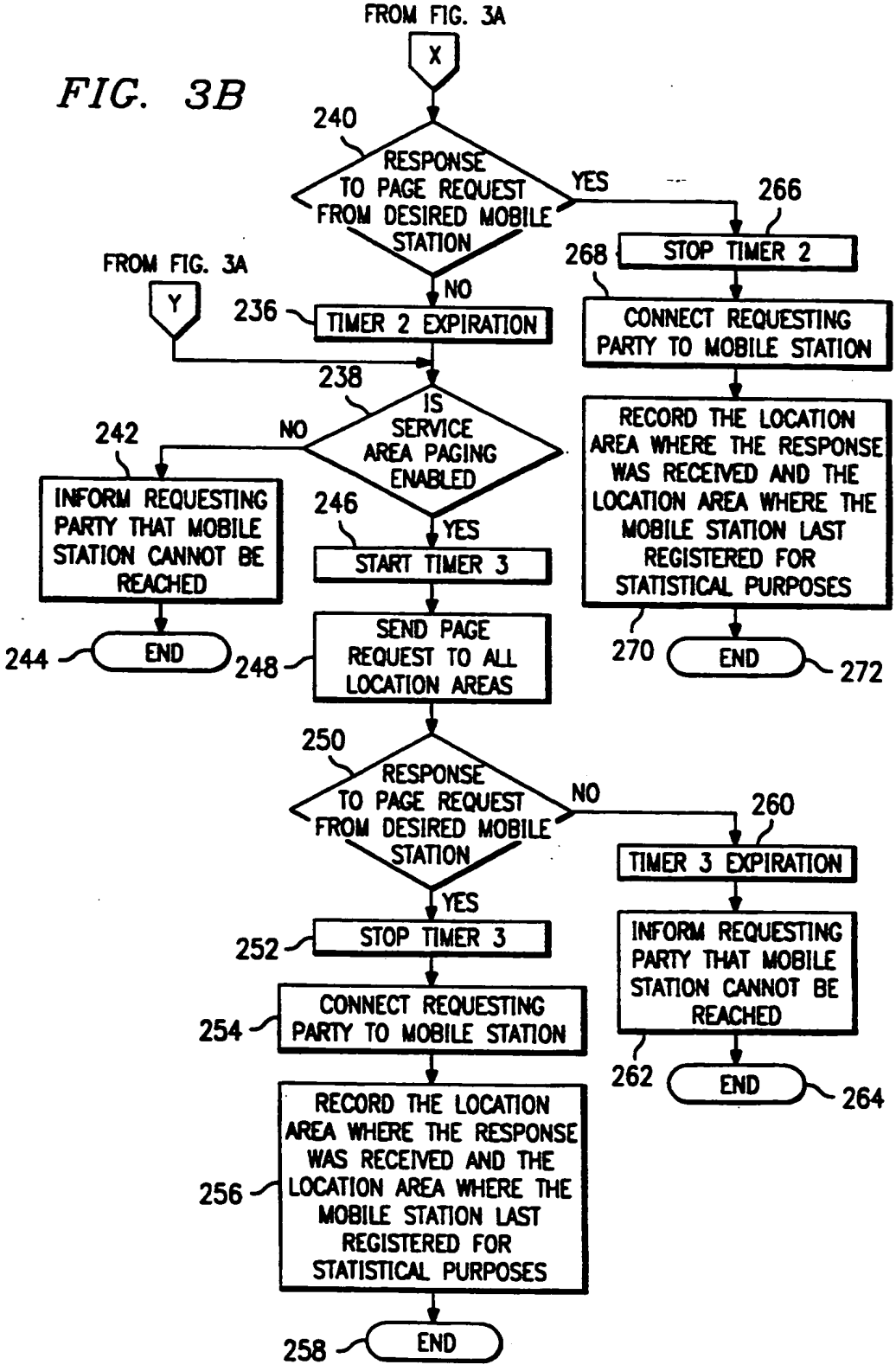

START
200
INCOMING PAGE REQUEST
202
DETERMINE THE LOCATION AREA WHERE DESIRED MOBILE STATION LAST REGISTERED
204
START TIMER 1
206
SEND PAGE REQUEST TO SPECIFIED LOCATION AREA
208
210
RESPONSE TO PAGE REQUEST FROM DESIRED MOBILE STATION
YES
212
STOP TIMER 1
214
CONNECT REQUESTING PARTY TO MOBILE STATION
RECORD THE LOCATION AREA WHERE THE RESPONSE WAS RECEIVED AND THE LOCATION AREA WHERE THE MOBILE STATION LAST REGISTERED FOR STATISTICAL PURPOSES
216
END
218
NO
220
TIMER 1 EXPIRATION
222
IS PAGING AREA PAGING ENABLED
NO
Y
TO FIG. 3B
YES
228
DETERMINE THE PAGING AREA ASSOCIATED WITH LOCATION AREA WHERE MOBILE STATION LAST REGISTERED
DETERMINE LIST OF LOCATION AREAS LOCATED WITHIN THE SPECIFIED PAGING AREA
230
START TIMER 2
232
SEND PAGE REQUEST TO ALL LOCATION AREAS WITHIN SPECIFIED LIST IN PAGING AREA
234
X
TO FIG. 3B

FIG. 3A

FIG. 3B


FROM FIG. 3A
X
240
RESPONSE TO PAGE REQUEST FROM DESIRED MOBILE STATION
YES
266
STOP TIMER 2
268
CONNECT REQUESTING PARTY TO MOBILE STATION
RECORD THE LOCATION AREA WHERE THE RESPONSE WAS RECEIVED AND THE LOCATION AREA WHERE THE MOBILE STATION LAST REGISTERED FOR STATISTICAL PURPOSES
270
END
272
FROM FIG. 3A
Y
NO
236
TIMER 2 EXPIRATION
238
IS SERVICE AREA PAGING ENABLED
NO
242
INFORM REQUESTING PARTY THAT MOBILE STATION CANNOT BE REACHED
244
END
246
YES
START TIMER 3
248
SEND PAGE REQUEST TO ALL LOCATION AREAS
250
RESPONSE TO PAGE REQUEST FROM DESIRED MOBILE STATION
NO
260
TIMER 3 EXPIRATION
INFORM REQUESTING PARTY THAT MOBILE STATION CANNOT BE REACHED
262
END
264
YES
252
STOP TIMER 3
254
CONNECT REQUESTING PARTY TO MOBILE STATION
256
RECORD THE LOCATION AREA WHERE THE RESPONSE WAS RECEIVED AND THE LOCATION AREA WHERE THE MOBILE STATION LAST REGISTERED FOR STATISTICAL PURPOSES
258
END

CELLULAR COMMUNICATIONS SYSTEM UTILIZING PAGING AREAS

CROSS REFERENCE TO RELATED APPLICATION

This application contains subject matter related to copending U.S. patent application Ser. No. 07,88,598 filed May. 12, 1992 now pending in the name of K. Raj Sanmugam, entitled "Paging System For Allocating Control Channel Paging Capacity," assigned to the assignee of the present invention and incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to paging within cellular communication systems, and more particularly, to the efficient allocation of paging distribution within a cellular communication system.

2. History of the Prior Art

Cellular radio communications is, perhaps, the fastest growing field in the world-wide telecommunications industry. Its growth has been such that in recent years the capacity of existing systems has been severely stressed to serve all of the subscribers who would like to have access to the system, particularly in major metropolitan areas. Moreover, cellular radio technology is currently moving from analog based systems, in which each subscriber communications channel is allotted to a single radio channel, to digital based systems in which a plurality of subscriber channels can be assigned to each radio channel through time division multiple access (TDMA) radio technology. In TDMA radio each channel is divided into a plurality of time slots and a digitized portion of each subscriber channel is broadcast in a different time slot.

However, despite the use of digital technology, such as TDMA, to increase cellular radio system capacity, the tremendous demand for cellular radio service is placing other demands on the system. For example, communication between the radio base stations within the system and the mobile stations within the system are divided into a plurality of voice or speech channels and at least one access or control channel, which may be either analog or digital and which may have any data rate. An illustrative one of such access or control channel is referred to as the forward control channel (FOCC).

Each mobile station which is operating within a cellular communications system must be locatable when a call is received by the system which is intended for that station. A mobile station is located by broadcasting a paging signal directed to the mobile and requesting it to respond if it receives the page. When the mobile broadcasts its page response signal to the page signal it is then placed on a voice channel by the base station and the call intended for the mobile can be connected to it through that voice channel. Cellular telecommunications systems employ a control channel such as the forward control channel (FOCC) as the means by which paging signals are broadcast into the various cells of the system in order to locate a particular mobile station. Thus, the more paging within a system the more radio traffic there is on the FOCC of the system. The continued subscriber growth within cellular systems along with the continued introduction of additional functionalities within the system will undoubtedly

greatly increase the paging load within each system and place an even higher demand for FOCC capacity within each system.

The capacity of the control channel, such as the FOCC, within a system may be limited because of at least two reasons. For example, the data rate over certain forward control channels is restricted to a rate on the order of 8-10 K bits per second which is a speed limitation imposed by the technology used in that implementation. Secondly, the control channel must also be utilized to transmit other messages to the mobile stations, including, for example, voice channel designations, directed retry orders, system ordered rescan signals and system overhead message trains each of which use substantial control channel capacity each time they are transmitted. Thus, it is desirable to utilize the control channel capacity in as an efficient manner as possible by paging in as localized an area as possible and still reliably locating the mobile station being sought by the system.

In conventional cellular radio systems, paging within each system is employed to serve not only its own paging needs but also the paging needs of the various cooperating exchanges which seek to locate mobile subscribers within the exchange in response to call requests within their own exchanges. Paging provides the service of attempting to locate a mobile station's whereabouts within the exchange in order to set up a call to that mobile station.

More specifically, the paging process in mobile cellular radio systems, attempts to identify the specific cell containing that mobile, as described above in connection with the paging process. During the execution of this process, the mobile switching center (MSC) searches for the mobile by sending a sequence of paging messages on the FOCC of the system and awaits a page response. Obviously, the page message muse be transmitted to all of the cell sites covering the entire service area of the system in order to ensure that the mobile is located regardless of where it might be within the system. This implies that when the use of paging capacity on all the control channels in the exchange is required, only one mobile can be paged at any given time. This limitation on cellular system capacity has been improved by the definition of "location areas" (LA's) wherein the entire service area of an exchange is divided into a plurality of different location areas. Each LA may consist of one or more individual cells within the system. Each mobile informs the system as to its specific LA identification either periodically or whenever it crosses a location area border by means of registration access within the system. The definition of LA's allows selective paging within the system thereby conserving paging capacity resources. That is, if the LA of a mobile station to be located is known then a page message for that mobile is sent only within that particular LA. As a result of this modification of the paging process, as many different mobile stations may be paged simultaneously as there as location areas within the system which greatly increases the paging capacity of the system.

In present systems, when a page remains unanswered by the mobile station which is sought, the page must be repeated. This repetition can be either within a location area previously paged or within the entire service area (SA) of the system. The present practice within cellular radio systems is to employ the paging process to handle

incoming page requests on a "first come, first served" basis. Depending upon whether the location area (LA) of the requested mobile station is known or not, the amount of paging capacity allocated to serve a particular page request is the same. That is, if the LA of the mobile station is known then the first page attempt is within the LA. Otherwise, it is within the service area SA which includes all of the LA's within the exchange. If no response is received to the page, the page is repeated either within the LA itself or within the SA.

When attempting to route a call to a mobile station, the MSC must specifically know in which cell the mobile station is located. In accomplishing the task of locating the mobile, the MSC pages the mobile station in the location area where the mobile station last registered. This prevents a global or system-wide page wherein all the cells within an exchange are paged simultaneously. If the mobile station does not answer the page request in the registered location area of its last registration, only then is service area or global paging required in order to locate the mobile.

Experience with the management of cellular communication systems has shown that a high percentage of mobile stations do not answer location area paging. There are three main causes for this problem. The first is the continual existence of earlier manufactured mobile stations which are able to store four different area identification codes (AIDs) within their internal memory. Such mobile stations will not perform forced registration if they remain within the same four location areas corresponding to the four AIDs stored within the mobile station's memory. If a mobile station moves from one of these four location areas to another, a forced registration does not occur and the mobile will not answer the page, thus requiring service area paging to contact the mobile.

As previously noted, the division of a service area into location areas was deemed advantageous to alleviate capacity problems within the FOCC, especially in those situations where the number of subscribers served by one MSC had reached a level on the order of 40,000 to 50,000 mobile stations. The FOCC cannot efficiently handle all page requests in a system utilizing only system-wide paging since all the cells within the system area are simultaneously paged. The division of the system area into location areas, which include a relatively small number of cells, was created to permit a page request to be directed to a specific location area if the desired mobile station was known to be located within that specific location area.

Whenever a mobile station crosses the border between two location areas, it is required to make a registration access to the MSC by means of a bit in the overhead message of the FOCC. Crossing of the border is detected by the mobile station due to the fact that the AID in the overhead message on the FOCC from the new location area is not equal to the AID received in a prior forced registration and stored within the mobile's memory. However, if a mobile station is able to store four AIDs within its internal memory, as the older models are able to do, then when it crosses the border between location areas whose AIDs are currently stored within the memory of the mobile station, a forced registration will not occur since the AID of the new location area is the same one of the AIDs of the prior location area stored within the memory of the mobile station. Thus, the mobile station will not answer a page directed to the location area of last registration, because the MSC will not have an accurate indication of where the mobile is currently located. This will continue as long as the mobile station remains within a group of four location areas, whose AIDs are stored within the mobile's memory, which is often the case.

The second reason why mobile stations often do not respond to a location area page relates to "rescanning" by the mobile stations. To ensure optimum performance, mobile stations access the system (for the purposes of registration, call initiation, and page response, for example) on the best available control channel. For this reason, before each access, the mobile station will "rescan" and listen to all the available control channels to choose the one having the best signal strength for access. The specification of the cellular system air interface standard causes the mobile stations to rescan both before and after every access. For example, when a mobile station detects that it has crossed a location area (or service area) border, it conducts a forced registration. The mobile station rescans for the control channel with the best signal strength, performs the forced registration message exchange and then rescans again, this time without checking whether or not the mobile station has again crossed a border. After the access, the mobile station then remains tuned to the best quality control channel it found during the second "rescan." If the second control channel found by the mobile station is different from the first, because the mobile crossed another border, the mobile station will not be tuned to the control channel of the location/service area in which it last registered and, thus, become "lost" to the system. This situation is quite common especially when a mobile station is moving along a border between location areas or exchanges. The control channels of the neighboring location areas or exchanges begin to compete with each other since both their respective signals are being received by the mobile station. The two signals will fade in and out as the mobile moves along the border.

In other words, if the second control channel belongs to a location area different than the control channel found when performing the first rescan, and the mobile is now located in the first location area, service area paging will be needed to find the mobile station. If the second control channel belongs to a neighboring exchange, the mobile station will not answer to any page at all from the first exchange and will not be able to receive any calls.

A third reason why a mobile station may not respond to a location area page is related to the addition of more and more subscribers to a mobile telephony system. In metropolitan areas, where there is a high concentration of subscribers, the cell radii are becoming smaller and smaller. The same cochannel reuse frequencies are being used by cells that are getting closer and closer in order to accommodate increased traffic density. Thus, when performing an access (specifically registrations), if the access is heard by more than one cell using the same control channel, there can be inconsistencies between where the MSC (or the mobile network if the multiple access is between cells that belong to different MSCs) believes the mobile is located and the actual location of the mobile. One solution to the capacity problem which is occurring within the available frequencies and the associated FOCC control channels is that of geographically closer frequency reuse. A utilization of both location and paging area paging allows for

a multiple use of the FOCC channel since multiple mobiles can be paged using the one FOCC channel.

Because of the foregoing problems inherent in existing cellular communication systems, it is desirable to introduce a system of paging utilizing paging areas, which allow paging within a greater number of cells than that of a location area without having to page in the entire service area. Paging areas serve as a middle step between location area paging and service area paging and thereby improve the capacity and the efficiency of the forward control channel. As an example, a service area can be divided into 16 location areas. If a paging area contains four location areas, the use of paging area paging reduces the load caused by a service area page by a factor of four. Service area paging can still be utilized if the mobile station does not respond to the paging area page. However, i f the paging areas are wisely defined by the system operator, a very small percentage of the calls will need service area paging.

This system of utilizing paging areas can also be implemented on a multi-exchange basis. In such a situation, paging areas may include within their borders location areas located in adjacent service areas.

SUMMARY OF THE INVENTION

In one aspect of the invention, paging areas composed of a plurality of location areas provide a means for locating a mobile station which has not responded to a location area page without requiring a service area page.

In another aspect, the present invention includes a system for paging mobile subscribers within the service area of a cellular communications system which comprises a plurality of cells grouped into contiguous locations areas each having one or more cells. Mobile subscribers are first paged in the particular location area within which they last registered with the system. Thereafter, the mobile subscribers are paged in a plurality of location areas within the service area of the system in response to failure of the mobile subscribers to respond to the particular location area pages. The location areas from which a page response is received from said mobile subscribers in response to said pages within a plurality of location areas are recorded. The location areas are then arranged in groups forming paging areas, each containing a plurality of locations areas and with each paging area being associated with a particular location area based upon the previously recorded statistical likelihood of locating a mobile within the particular group of location areas comprising a paging area when it last registered in the associated location area. The plurality of location areas within which the mobile subscribers are paged, following failure to respond to a location area page, may be either a paging area or all of the location areas within the service area of the system.

In still another aspect, the present invention includes a system for paging mobile stations within a cellular telecommunications system in which groups of cells are arranged in location areas and groups of location areas are arranged in paging areas. A call request for a desired mobile station is received from a calling party, the location area within which the desired mobile station last registered is determined and a page request is sent to the location area. The calling party is connected to the mobile station if a page response is received from the mobile station in response to the page request. If both paging area paging and service area paging is not enabled for the system and a page response is not received from the mobile station in response to the page request the calling party is informed that the mobile station is not available. If paging area paging is enabled for the system, the paging area which is associated with the location area where the mobile station last registered is determined. Next, a list of a plurality of location areas defined by the paging area is determined and a page request is sent to the plurality of location areas within the paging area. The calling party is connected to the mobile station if a page response is received from the mobile station in response to the page request. If, however, service area paging is not enabled for the system and a page response is not received from the mobile station as a result of the page request, the calling party is informed that the mobile station is not available. I f, however, service area paging is enabled for the system a page request is sent to all location areas within the service area. The calling party is informed that the mobile station is not available if a page response is not received from said mobile station in response to the service area page.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a pictorial representation of a cellular radio communication system including a mobile switching center, a plurality of base stations, and a plurality of mobile stations;

FIG. 2 is a block diagram illustrating the organization of an exemplary cellular radio service area partitioned into location areas, paging areas, and service areas; and

FIG. 3A–3B is a flow chart illustrating the manner in which paging requests are handled, including the utilization of paging areas in accordance with the system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is illustrated a conventional cellular radio communications system of the type to which the present invention generally pertains. In FIG. 1, an arbitrary geographic area may be divided into a plurality of contiguous radio coverage areas, or cells C1–C10. While the system of FIG. 1 is illustratively shown to include only 10 cells, it should be clearly understood that in practice, the number of cells will be much larger.

Associated with and located within each of the cells C1–C10 is a base station designated as a corresponding one of a plurality of base stations B1–B10. Each of the base stations B1–B10 includes a transmitter, a receiver, and base station controller as are well known in the art. In FIG. 1, the base stations B1–B10 are illustratively located at the center of each of the cells C1–C10, respectively, and are equipped with omni-directional antennas. However, in other configurations of a cellular radio system, the base stations B1–B10 may be located near the periphery, or otherwise away from the centers of the cells C1–C10 and may illuminate the cells C1–C10 with radio signals either omni-directionally or directionally. Therefore, the representation of the cellular radio system of FIG. 1 is for purposes of illustration only and is not intended as a limitation on the possible implementations of the cellular radio system within

which the system of the present invention is implemented.

With continuing reference to FIG. 1, a plurality of mobile stations M1–M10 may be found within the cells C1–C10. Again, only 10 mobile stations are shown in FIG. 1 but it should be understood that the actual number of mobile stations will be much larger in practice and will invariably greatly exceed the number of base stations. Moreover, while none of the mobile stations M1–M10 may be found in some of the cells C1–C10, the presence or absence of the mobile stations M1–M10 in any particular one of the cells C1–C10 should be understood to depend, in practice on the individual desires of the mobile stations M1–M10 who may roam from one location in the cell to another or from one cell to an adjacent cell or neighboring cell, and even from one cellular radio system served by an MSC to another such system.

Each of the mobile stations M1–M10 is capable of initiating or receiving a telephone call through one or more of the base stations B1–B10 and a mobile switching center MSC. A mobile switching center MSC is connected by communication links, e.g., cables, to each of the illustrative base stations B1–B10 and to the fixed public switched telephone network PSTN, not shown, or a similar fixed network which may include an integrated system digital network (ISDN) facility. The relevant connections between the mobile switching center MSC and the base stations B1–B10, or between the mobile switching center MSC and the PSTN or ISDN, are not completely shown in FIG. 1 but are well known to those of ordinary skill in the art. Similarly, it is also known to include more than one mobile switching center in a cellular radio system and to connect each additional mobile switching center to a different group of base stations and to other mobile switching centers via cable or radio links.

Each of the cells C1–C10 is allocated a plurality of voice or speech channels and at least one access or control channel, such as a forward control channel (FOCC). The control channel is used to control or supervise the operation of mobile stations by means of information transmitted to and received from those units. Such information may include incoming call signals, outgoing call signals, page signals, page response signals, location registration signals, voice channel assignments, and maintenance instructions as a mobile station travels out of the radio coverage of one cell and into the radio coverage of another cell. The control or voice channels may operate either in an analog or digital mode or a combination thereof.

Referring next to FIG. 2, there is shown a block diagram of a portion of the coverage area of an illustrative cellular radio system served by a particular MSC in which the cells, illustrated in FIG. 1, are organized into groupings to enable the more efficient utilization of the system resources. In FIG. 2, there are defined a plurality of location areas 101 shown as being thirty-two in number and numbered 0–31. Each location area (LA) 101 may include one or more individual cells. In addition, each location area 101 is surrounded by an additional grouping of location areas which together comprise a paging area (PA) 102. For example, the paging area 102 surrounding location area "3" includes location areas 1, 2, 3, 13, 14, 15, 4, 5 and 0. Finally, all of the location areas 101 taken together comprise the service area (SA) 103 of the system.

As shown in FIG. 2, the entire service area SA 103 is divided, by way of example, into thirty-two location areas LAs 101. Each mobile station informs the system of its current LA identification number by broadcasting that identification number either periodically or whenever the mobile crosses a location area border and is caused to do so by known registration access processes. The definition of the location areas 101 allows selective paging within the system. That is, if the location area of a particular mobile station desired to be located is known then the paging message is only sent within that particular location area. Thus, as many as thirty-two mobile stations may be paged simultaneously within the service area 103. It should be understood that the paging area within which a mobile is paged following an unanswered page within a location area may or may not include that location area depending on the particular circumstances.

An unanswered page is generally repeated. However, this repetition can be repeated within either the location area already paged, within the area surrounding the location area 101, i.e. the paging area 102, or within the entire service area 103. FIG. 2 illustrates the composition of the various paging fields comprising the location areas 101, paging area 102, and service area 103. For example, if initial paging is performed within location area "3" and no response is obtained, the next page could be broadcast within the paging area 102 surrounding location area "3" , and if still no response is obtained from the mobile, the page could be repeated within the entire service area 103, covering all of the location areas 0–31. If, however, no particular location area is known for the mobile which is desired to be located, the paging must be by definition within the entire service area 103 including all thirty-two of the location areas 0–31.

It could be observed from FIG. 2 that the breadth of the paging field, i.e. , LA, PA, or SA, generally represents the extent of the control channel (FOCC) capacity required to broadcast the paging message to the mobile within that field. That is, broadcasting a page within the entire service area requires paging capacity from all of the base stations in the exchange, while paging within one paging area requires capacity from fewer base stations and so forth. Various techniques may be employed to optimize the paging capacity of the FOCC such as those taught in copending U.S. patent application Ser. No. 07/881,598 filed May 12, 1992 now pending in the name of K. Raj Sanmugam, entitled "Paging System For Allocating Control Channel Paging Capacity" and assigned to the assignee of the present invention which is hereby incorporated by reference herein.

Referring next to the flow chart of FIG. 3A–3B, it is there illustrated how the system of the present invention implements a page request coming into the system. The procedure begins at 200, and at 202, an incoming page request is accepted into the system. Thereafter, at 204 the system recalls from its memory the location area from where the desired mobile station last registered. Next, at 206, a timer is started to establish how long one will wait for a response to a page request that will be transmitted to the specified location area where the mobile station last registered. At 208, the system sends a page request to the specified location area where the mobile station last registered. The system then asks at 210 whether a page response has been received from the desired mobile station. If a page response has been re-

ceived from the mobile station, the system proceeds to 212 where the timer is stopped. Next, at 214, the system connects the mobile station to the requesting calling party. Thereafter, at 216 the system records the identity of the location area from which the response was received and where the mobile station last registered for statistical purposes. These statistics will be utilized in further optimizing the coverage of the location areas and the paging areas. The paging process ends at 218.

If at 210, a page response is not received from the mobile station, the system proceeds to 220 where the timer expires. Next, at 222 the system asks whether paging area paging has been enabled. If paging area paging has not been enabled, the system proceeds to 238 where it is determined whether or not service area paging is enabled for the system. If service area paging has not been enabled, the system proceeds to 242 where the calling party is informed that the mobile station cannot be reached. The paging process then ends at 244.

If, at 222 it is determined that paging area paging has been enabled, the system proceeds to 228 where the system retrieves from its memory the paging area parameters associated with the location area where the mobile last registered. Next, at 230 the system retrieves the list of the particular location areas defined by the specified paging area parameters. Thereafter, at 232 a second timer is started to establish how long one will wait for a response to a page request which will be transmitted to the specified paging area. At 234, the system sends a page request to each of the location areas within the defined paging area. The system asks at 240 whether a page response has been received from the desired mobile station. If so, at 266 the second timer is stopped; thereafter, the system at 268 connects the calling party to the desired mobile station. At 270 the system records the location area from which a page response was received and where the mobile station last registered for statistical purposes. The paging process ends at 272.

If at 240, a page response is not received by the system from the desired mobile station the second timer will expire at 236. The system then asks at 238 whether service area paging has been enabled for the system. If service area paging has not been enabled the system proceeds to 242 where the calling party is informed that the mobile station cannot be reached. The paging process then ends at 244.

If at 238 service area paging has been enabled for the system, then, at 246, a third timer is started. Thereafter, at 248 the system sends page requests to all location areas within the system area. The system then asks at 250 whether a page response has been received from the desired mobile station. If yes, at 252, the third timer is stopped. Next, at 254 the calling party is connected to the desired mobile station; and, at 256 the system records the location area from which the response was received and where the mobile station last registered for statistical purposes. The paging process then ends at 258.

If, at 250 a page response is not received from the desired mobile station, at 260 the third timer will expire. Next, at 262 the system will inform the calling party that the mobile station cannot be reached. The paging process then end at 264.

In summary, the paging process optimizes the use of the control channel capacity by first sending a page request to the last known location of the desired mobile station. If no response is received within a specified time period, page requests are sent to a group of predetermined location areas, i.e. a paging area, which includes the location area where the desired mobile station last registered and a plurality of location areas wherein the mobile station would be statistically likely to be found if it had last registered within the previously paged location area. This paging area includes more than one location area and less than the total of all location areas within the system area. A paging area may also extend into and include location areas within a contiguous neighboring cellular system. If a response is still not received from the mobile station after the paging area page, then a service area page will be transmitted.

It should be noted that the statistical information gathered by the system relating the location area in which a mobile was actually located (based upon a response to either a paging area page or a service area page) to the location in which it last registered forms a basis for the grouping of location areas into paging areas. That is, the idiosyncratics of the geographic terrain and obstructions of a system will affect the reception of radio signals in different cells and location areas thereof and these statistical data enable an operator to configure both contiguous and overlapping paging areas to optimize the likelihood of locating the mobile while minimizing the load on the control channel capacity of the system.

As can be seen from the above description, the present invention allows a cellular communication system operator to create a paging area, associated with each location area and comprising a plurality of additional location areas in the region thereof, where a mobile subscriber is most likely to be found if it must be paged outside the location area of its last registration. Since each paging area is composed of a plurality of location areas their use helps overcome uncertainties in pinpointing the exact location of a mobile station while using the available paging capacity more efficiently by reducing the requirement for service area paging.

It is believed that the operation and construction of the present invention will be apparent from the foregoing description and, while the method and apparatus shown and described has been characterized as being preferred, obvious changes and modifications may be made therein without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. A method of paging mobile stations within a cellular telecommunication system in which groups of cells are arranged in location areas and groups of location areas are arranged in paging areas, said method comprising the steps of:

receiving from a calling party a call request for a desired mobile station;

determining within which location area said desired mobile station last registered;

sending a first paging message to said location area within which said desired mobile station last registered;

connecting said calling party to said desired mobile station if a page response is received from said desired mobile station in response to said first paging message;

determining if paging area paging is enabled for said telecommunication system if a page response is not received from said desired mobile station in response to said first paging message;

informing said calling party that said desired mobile station is not available if paging area paging is not enabled for said telecommunication system;

determining which paging area is associated with the location area in which said mobile station last registered if paging area paging is enabled for said telecommunication system;

accessing a list including a plurality of location areas defined by said paging area;

sending a second paging message to said plurality of location areas within said paging area;

connecting said calling party to said desired mobile station if a page response is received from said desired mobile station in response to said second paging message;

determining if service area paging is enabled for said telecommunication system if a page response is not received from said desired mobile station as a result of said second paging message;

informing said calling party that said desired mobile station is not available if service area paging is not enabled for said telecommunication system;

sending a third paging message to all location areas within said service area if service area paging is enabled for said telecommunication system; and

informing said calling party that said desired mobile station is not available if a page response is not received from said desired mobile station in response to said third paging message.

2. A method of paging within a cellular telecommunication system as set forth in claim 1 wherein said step of sending a second paging message to said plurality of location areas within said paging area includes sending said second paging message to more than one location area and fewer location areas than are contained within said service area.

3. A method of optimizing the utilization of forward control channel resources within a cellular telecommunication system in which groups of cells are arranged in location areas and groups of location areas are arranged in paging areas making up the service area, said method comprising the steps of:

receiving from a calling party a call request for a desired mobile station;

determining within which location area said desired mobile station last registered;

sending a first paging message to said location area;

connecting said calling party to said mobile station if a page response is received from said mobile station in response to said first paging message;

determining if paging area paging is enabled for said system if a page response is not received from said mobile station in response to said first paging message;

informing said calling party that said mobile station is not available if paging area paging is not enabled for said system;

determining which paging area is associated with the location area in which said mobile station last registered if paging area paging is enabled for said system;

accessing a list including a plurality of location areas defined by said paging area;

sending a second paging message to said plurality of location areas within said paging area;

connecting said calling party to said mobile station if a page response is received from said mobile station in response to said second paging message;

determining if service area paging is enabled for said system if a page response is not received from said mobile station as a result of said second paging message;

informing said calling party that said mobile station is not available if service area paging is not enabled for said system;

sending a third page attempt to all location areas within said service area if service area paging is enabled for said system; and

informing said calling party that said mobile station is not available if a page response is not received from said mobile station in response to said third paging message.

4. A method of optimizing utilization of forward control channel resources within a cellular telecommunication system as set forth in claim 3 wherein said step of sending a second paging message to said plurality of location areas within said paging area includes sending said second paging message to more than one location area and fewer location areas than are contained within said service area.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,369,681
DATED : November 29, 1994
INVENTOR(S) : Alain Boudreau et al.

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 8	Delete "07,88,598" Insert --07/881,598--.
Column 1, line 9	After "May" Delete ",".
Column 1, line 16	Delete "FIELD OF THE INVENTION" Insert --Field of the Invention--.
Column 5, line 17	Delete "i f" Insert --if--.
Column 6, line 15	Delete "I f" Insert --If--.

Signed and Sealed this

Twenty-seventh Day of February, 1996

Attest:

Attesting Officer

BRUCE LEHMAN

Commissioner of Patents and Trademarks